Technical information for private, trunked and public safety networks.

MRT

MOBILE RADIO TECHNOLOGY

APRIL 2001

IWCE 2001
International Wireless Communications Expo

25th Anniversary

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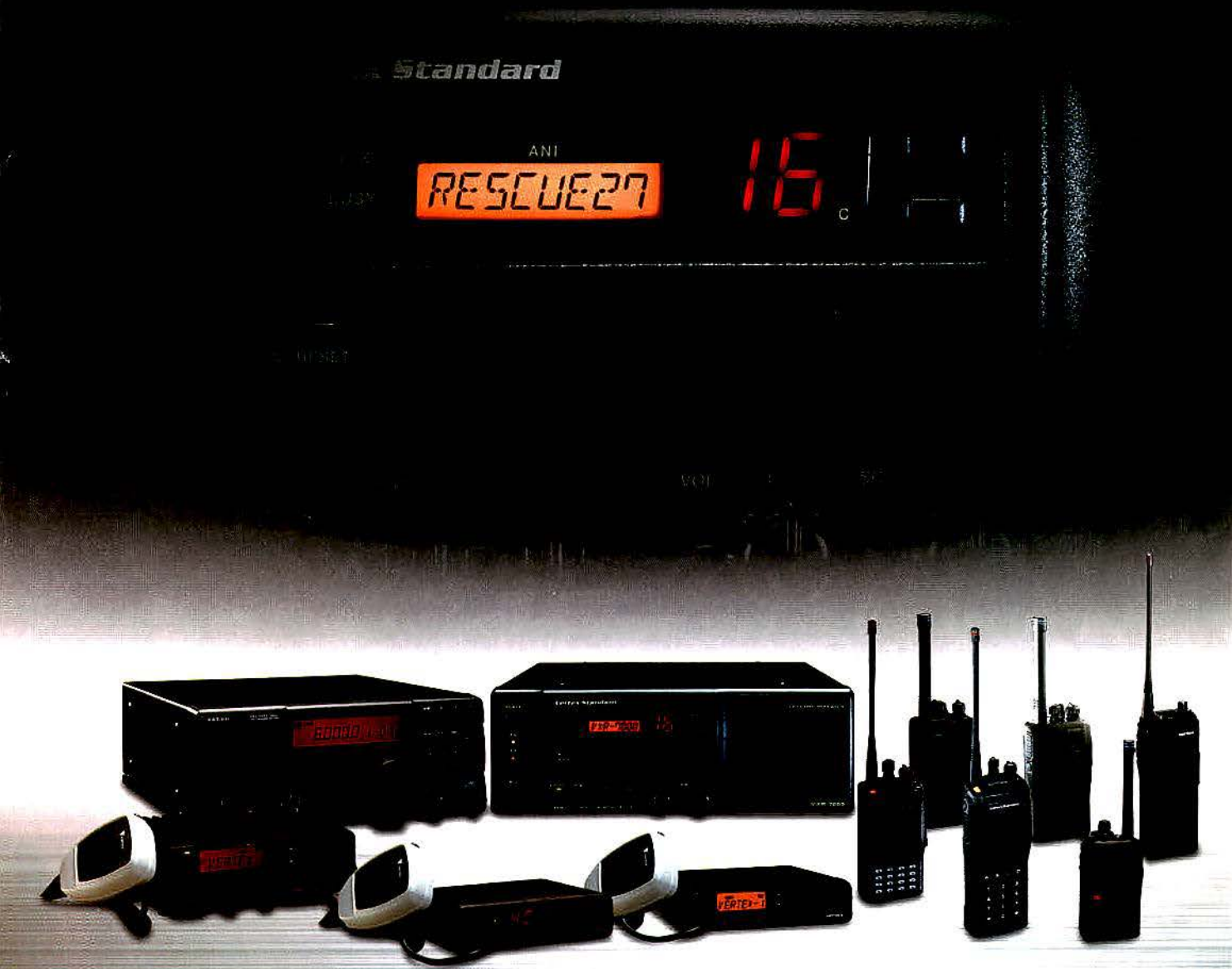

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SS-12	10	12	1⅞ x 6 x 9	3.4
SS-18	15	18	1⅞ x 6 x 9	3.6
SS-25	20	25	2¾ x 7 x 9¾	4.2
SS-30	25	30	3¾ x 7 x 9¾	5.0

MODEL SS-25M

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MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SS-25M*	20	25	2¾ x 7 x 9¾	4.2
SS-30M*	25	30	3¾ x 7 x 9¾	5.0

MODEL SRM-30

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MODEL	CONT. (Amps)	ICS	SIZE (Inches)	Wt.(lbs.)
SRM-10	7	10	3½ x 19 x 9¾	4.3
SRM-12	10	12	3½ x 19 x 9¾	4.7
SRM-18	15	18	3½ x 19 x 9¾	5.0
SRM-25	20	25	3½ x 19 x 9¾	6.5
SRM-30	25	30	3½ x 19 x 9¾	7.0

WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25M	20	25	3½ x 19 x 9¾	6.5
SRM-30M	25	30	3½ x 19 x 9¾	7.0

MODEL SRM-30M-2

2 ea SWITCHING POWER SUPPLIES ON ONE RACK PANEL

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25-2	20	25	3½ x 19 x 9¾	10.5
SRM-30-2	25	30	3½ x 19 x 9¾	11.0

WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25M-2	20	25	3½ x 19 x 9¾	10.5
SRM-30M-2	25	30	3½ x 19 x 9¾	11.0

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MODEL SS-10EFJ-98

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NEW SWITCHING MODELS

SS-10GX, SS-12GX
SS-18GX
SS-12EFJ
SS-18EFJ
SS-10-EFJ-98, SS-12-EFJ-98, SS-18-EFJ-98
SS-12MC
SS-10MG, SS-12MG
SS-101F, SS-121F
SS-10TK
SS-12TK OR SS-18TK
SS-10SM/GTX
SS-10SM/GTX, SS-12SM/GTX, SS-18SM/GTX
SS-10RA
SS-12RA
SS-18RA
SS-10SMU, SS-12SMU, SS-18SMU
SS-10V, SS-12V, SS-18V

*ICS – Intermittent Communication Service

On the cover: Dallas has its fair share of 800MHz, PCS, UHF and other providers. A few VHF sites, however, provide a wide area of coverage. Story on page 32.

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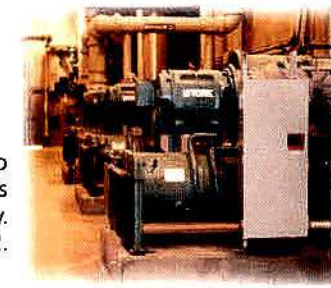
APRIL 2001
Volume 19, Issue 4



San Diego sets up 800MHz coverage at its water-reclamation facility. See page 52.

Features

Tower companies are being typecast as transmitters or carriers, when they are actually commercial real estate—period. See page 10.

Departments

MRT
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on the web

Visit **www.mrtmag.com** to get industry news and information that you won't find in the magazine.

Check the "Calendar of Events" for industry-relevant exhibitions and conferences.

WWW.MRTMAG.COM - highlights

Bush proposes fix for FCC wireless auctions
The Bush administration has raised questions about whether the September 700MHz auction will be postponed until 2003.

RF Industries: Business is good, but SEC investigates
RF Industries expects to report record first-quarter results.

Central Texas radio coalition selects Motorola
The city of Austin, TX, has awarded a $61.2 million contract to Motorola for a new 800MHz communications system.

FCC Commissioner Ness won't seek reappointment
The most senior member of the FCC, Susan Ness, will not seek a second term.

Industry media
Kathrein, Scala Division, activates new Web site.

Industry people
David Gilden joins Ranger Communications as international sales manager.

Reader letters
Dealers need to communicate more ("POS Perspective" feedback).

Calendar of events
Pack your suitcase for mobile radio trade shows.

How to get an article in *MRT*
Be an author—guidelines for submitting articles.

Marketing services
Marketing contacts and advertising opportunities.

Industry links
Links to industry association Web sites.

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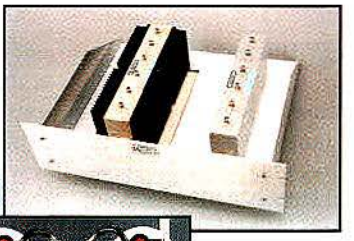

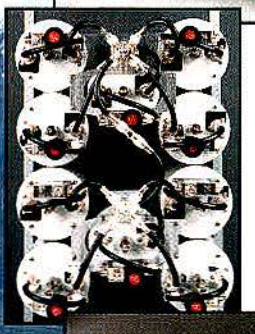

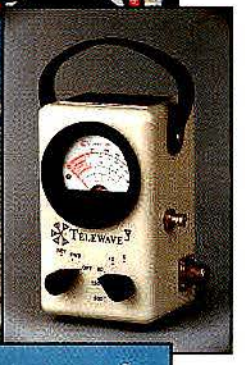

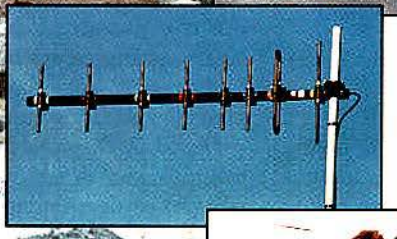

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Happy 25th anniversary, IWCE

It's been 25 years since the first 150 attendees came to attend sessions and view tabletop exhibits at International Wireless Communications Expo's precursor, the National Mobile Radio Dealers conference.

I joined the magazine in April 1983, so counting this year's event, I've only been to 19 of the annual events. A newcomer!

Twenty-five years ago, a strong supporter of public safety radio communications, Fred M. Link, delivered the keynote address. This year, another public safety advocate, Kathleen Wallman, is the keynoter. Ms. Wallman chairs the FCC Public Safety National Coordination Committee that's working out details regarding public safety agency use of the 700MHz band.

Mercy Contreras, our group publisher, told me the names of some people who were with her at the first IWCE: Randy Friedberg, Don Clark, Jeff Grazi, Marty Cooper, Steve Beeferman, Gregg Miller, Mal Gurian, Perry Easterling, Jimmy Tucker and David Ferrell. Some will be at this year's event, and some have moved on to work in other industries.

OK, Laura, it's your turn. Say something you claim you wish hadn't said quite so bluntly but that we can quote anyway. Isn't that your style, Mark?

New faces come each year. About 8,500 attendees and 1,500 exhibitor staff make up the expected 10,000 registration. I hope you're one of them.

Say it ain't so, Mark!

After 31 years at the Industrial Telecommunications Association, (once the Special Industrial Radio Service Association), Mark Crosby has stepped down as president. He has moved over to lead his brainchild, Access Spectrum, a 700MHz band manager. Laura Smith advances to president from her post as ITA's executive director of government relations.

Private radio needs strong advocacy. Since the old National Association of Business and Educational Radio merged with the Personal Communications Industry Association, ITA and other associations have shouldered a growing responsibility. NABER boosted private radio and small business; PCIA gets more mileage out of commercial services and big business.

Small Business in Telecommunications, American Mobile Telecommunications Association, United

Telecom Council and others also play important roles.

But there's only one Mark Crosby. Focused, outspoken and tireless, he's someone we always enjoy hearing when he speaks to audiences at IWCE. He also makes for good magazine copy.

OK, Laura, it's your turn. Say something you claim you wish you hadn't said quite so bluntly but that we can quote, anyway. Isn't that your style, Mark?

New editorial staff

We welcome new members to the editorial staff, including Roger Lesser, editor; Maurice Lydick, senior art director; and Kari Taylor, associate editor. A story about our new colleagues appears on page 71. Along with David Keckler, technical editor; Nikki Chandler, senior associate editor; and Scott Dolash, art director, we look forward to seeing you at IWCE.

You can look in on the trade show via the Internet. On page 8, Associate Editor Matthew Halverson explains how to find IWCE in cyberspace using our Web site at **www.mrtmag.com.**

In the news

Several of our editorial advisers, consultants, columnists and contributing editors are making news.

Alan Burton, the founding editor of *Dispatch Monthly*, has written a novel titled *The Amateur Terrorist*. No publication date has been set, but the manuscript is finished. Congratulations, Alan.

Frederick G. Griffin, P.E., has applied for a position with the Bush Administration. He wants to fill a vacant seat on the FCC. It's been a half-century since the FCC had the benefit of an engineer among its commissioners. I don't know whether someone who applied to be a commissioner has ever been appointed—the job normally goes to political types chosen by administration insiders. But can you imagine the potential for improved decision-making with an engineer taking part? Good luck, Fred. Your kind of expertise would be welcome.

David O. Dunford has retired as technical supervisor for the Lenexa, KS, police department. He hasn't left the department too far behind. His business card now reads "consultant," and the department is one of his clients. Best wishes to Dave with the "new" career.

Patrick E. Buller has retired from the Washington State Patrol as an electronics design engineer to take a new assignment as special projects engineer with Tacoma Power. Among other features, Pat has written some of our best do-it-yourself technical articles.

Don Bishop

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Live! and direct

Chances are, in a couple years the trade show as we know it will be the next activity to be assimilated into the increasingly pervasive world of the Internet. Businesses with no physical storefront to speak of are setting up shop on the Net, and now even colleges are offering courses online. It would appear that activities that once required human interaction are being supplemented by monitors and broadband lines.

"But trade shows?" you say. "That's all conjecture and wide speculation. We want proof!" Ladies and gentlemen of the jury, I give you IWCE Live!

From the people that bring you *Mobile Radio Technology* and the International Wireless Communications Expo itself, comes an entire Web site devoted to bringing you updates from the show floor as they happen.

So, you spent a late night in the casinos, and now you're too tired to make it to the show? Roll out of bed, turn on the laptop and log on to **www.mrtmag.com**. Click on the "IWCE 2000" logo. The IWCE Live! button is at the bottom of the page.

While you were busy blowing on dice and praying for a hard eight, the sleep-deprived editors of *MRT* were hunched over keyboards pounding out stories on the previous day's events.

While you were busy blowing on dice and praying for a hard eight, *MRT's* editors were hunched over the keyboards.

Daily recaps would be sufficient, and if the only "dealers" you talked to while in Vegas were at the black jack tables, that's all you would deserve. But *MRT* likes to spoil you.

Throughout the show, IWCE Live! will bring you, in keeping with its name, *live* updates from the floor. Wondering what exhibitors and attendees have to say about the show's turnout? The site's "The Word on the Street" section will provide you with quotes from those in attendance. Are the two sessions you just *had* to go to scheduled at the same time? "Conference Highlights" will give you the low down on what went on at those discussions you missed.

And what would a trade show be without product announcements? If a new product is displayed at IWCE, Live! will let you know about it. Lest we deprive you of visual stimuli, the reports will be accompanied by snapshots from the show in the "Scrapbook" section.

For up-to-the-minute exhibitor and conference updates, just check the "Show Directory Updates" and "Daily Stats and Conference Highlights" sections. The trade show staff will also be posting special events under "What's Happening Today."

If you do make it to the show, though, that doesn't mean you can't enjoy the site, as well. Visit the *MRT* booth to access Live! from the staff's on-site Web station. Members of the staff will be on hand to show you where to go to find the best information on the site. You will also be able to access Live! in the registration area on one of the two computers provided. (Don't forget to check your email too.)

The idea of a virtual trade show may not be as farfetched as you think, and *MRT* and IWCE Live! are paving the way. Just imagine the possibilities: less air travel, no more canceled hotel reservations and more time to spend at the casinos.

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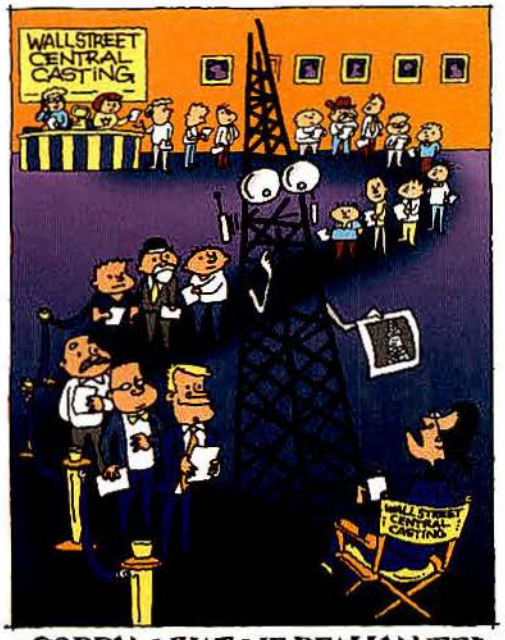
Put in the wrong company

By Robert H. Schwaninger Jr.

Out of Hollywood, we always hear about actors who don't want to be typecast. Ray Walston didn't want to be always known as a Martian, and Bob Denver still wants off "Typecast Island." The problem is that once people get stuck in a role long enough, they can become *permanently* stuck.

An old friend of mine has a mother-in-law who still thinks that I'm the devil because *I* got him drunk the night before his wedding. Sure, I had help from three other guys (and we didn't exactly force-feed him). But, to his sainted mother-in-law, I will always be the one who led the groom astray.



"SORRY, WHAT WE REALLY NEED IS AN INCOME GENERATOR... AND WE WANT SOMEBODY TALLER."

Companies can suffer the same fate as people. They can get pigeonholed by the investment community, and soon they can't shake the monikers or modifiers with which they are tagged.

Take radio tower companies, for example. Through a recent round robin of meetings with the chief financial analysts of four major brokerage houses that "cover" towers, I found out that not one of them had radio towers in the right niche.

They had tucked towers in with transmitters or carrier stocks. That is wrong.

Towers are commercial real estate—period.

Whether the carriers are having a good year or a bad one, they still pay their rent. Even when carriers don't buy new transmitters, they still pay rent on the places where their existing transmitters are located.

So, radio tower companies aren't carriers, and they aren't RF equipment companies. But watch the wizards of Wall Street punish radio tower companies along with everyone else when tech stocks are tanking.

Why? Typecasting.

How about local operators? Talk about your *typecasting*. So often, the FCC implies that local dealers represent yesterday, while the largest carriers represent the future. They might be right—if the future is filled with companies carrying billions in debt to produce products and services that the public neither wants nor can afford.

"But ain't it a *killer* app?" Well, in the words of valley girls everywhere, "That's so-o-o last administration."

The politics and policies of today are about reducing debt and increasing savings. The government itself looks for ways to do less *with* less and to reduce the national debt. It encourages consumers to avoid too much consumer debt and to put more money into savings that can be used to capitalize a

Schwaninger, *MRT's* regulatory consultant, is the principal in the law firm of Schwaninger & Associates, Washington, which is counsel to Small Business in Telecommunications. Schwaninger is also a member of the Radio Club of America.

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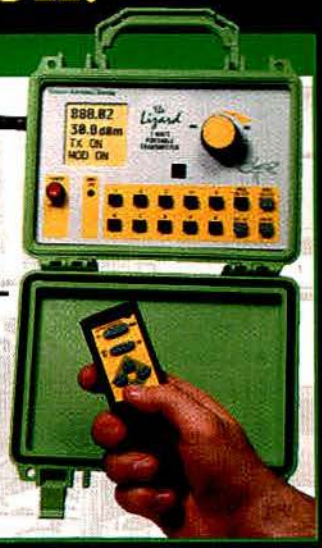

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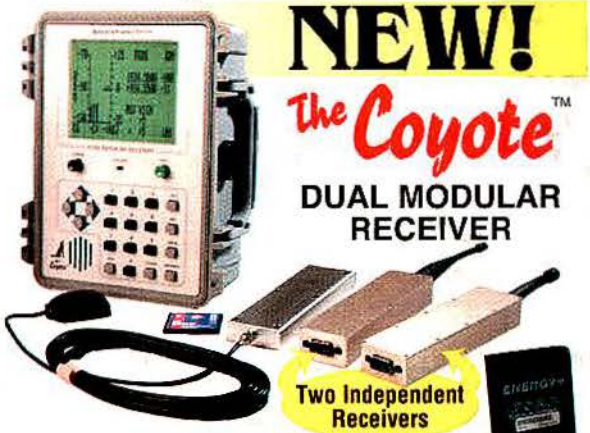

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Circle (10) on Fast Fact Card

growing economy.

In other words, the government is saying to all of us, "Be fiscally conservative—but confident." Oddly, this is exactly what *local dealers* do.

Local and regional operators spend money on intelligent growth, but they realize that frequently spending several million dollars in their market might not be the brightest move. It's that *math* thing. It keeps telling them that to recover those millions, they would need to sell radio service to every man, woman, child, weasel and tree within a 70-mile radius for a period roughly equal to the time it would take to deforest Brazil using a weed whacker.

Yet, the FCC will encourage, cajole and reward the big boys for extravagant expeditures (if they are also willing to pay for the privilege of evoking Chapter 11 by first giving the FCC some of their borrowed boodle).

So why are the feds saying that *their* books should balance but carriers' books should have more red than an embarrassed cardinal?

Furthermore, how come when some company behaves in a truly silly way (read: Verizon's bid for the New York PCS market), the FCC doesn't admit that *maybe* its little sales pitch about the future of emerging technologies has reached the Land O'Looney?

You know, we could just rock back and watch the titans toss cash to the wind—if the agency didn't applaud it. Local operators could chuckle and say, "Glad it ain't my money." The truth is, it *is* their money. When the FCC typecasts an industry segment into oblivion, and your company is a member of that segment, you *are* being injured.

The agency conveniently forgets that rules that might make sense for large companies are disastrous for smaller operators. The FCC *could* make decisions that favor cash over commitment. The agency *could* embrace the contributions of its entrepreneur class and stop being impressed with the homogenized output of the line-item boys. The commissioners *could* embrace advantages for local communities and forget about the "global community," in which no one truly lives or works.

It is about not being typecast as a has-been (or never-was) or being viewed as a quaint historical reference rather than as an important contributor to this industry. It is about being taken seriously by administrators who have too long rewarded the ridiculous (albeit publicly traded) performer. It is ultimately about pride.

The FCC will encourage, cajole and reward the big boys for extravagant expeditures (if they are also willing to pay for the privilege of evoking Chapter 11 by first giving the FCC some of their borrowed boodle).

I am proud of local dealers whose priorities run first to God, family, customers and integrity—before profit. I like dealing with clients who pay their bills when due (mostly)—not because their system kicks out a pre-printed check on the third day of each month, but because they believe it's the *right thing* to do.

I also like the fact that, in my 20 years of representing small and regional businesses throughout the country, only one client ever went bankrupt (not a bad average).

Compare that to the big boys.

So, Chairman Powell, the next time you speak about the Mercedes Gap (the gap between the rich and the poor), answer whether you would like to reward the spendthrift who drives the Mercedes on borrowed money or the guy who *paid* for his Chevy. But whatever you do, don't lump the local dealers into the invisible or irrelevant file. Local communities need them, and the FCC should certainly respect them. ■

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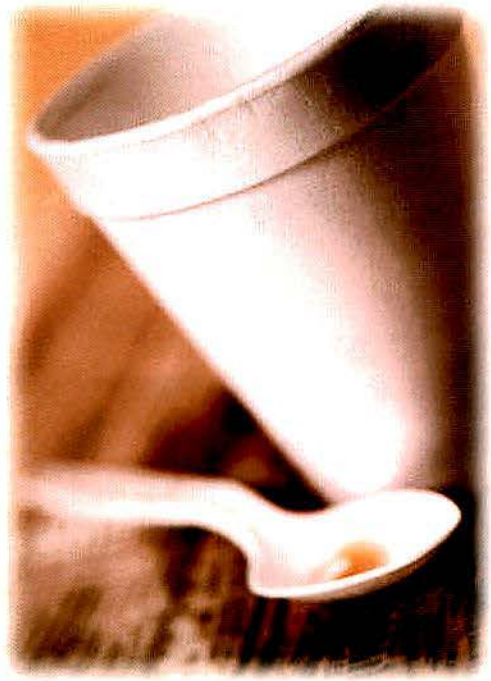
Yankee ingenuity

It's what makes radio systems great.

By David O. Dunford

Back in 1990 when Grumpy and I attended the AT&T PBX school in Atlanta, all the locals found out we lived in Kansas and accused us of being "Yankees" and "probably even voting Republican." Later, at the Orbacom console factory school in Cinnaminson, NJ, the locals thought that, living in Kansas, we were southerners (and *rubes* at that.) Locals in New York plainly asked "What part of New York is Kansas in?" Clearly the lines of geographic origin are blurring.



Communication: Swap a cup of coffee (decaf) for some insights from the comms center manager.

But I still believe that the correct term for this month's opinions is "Yankee Ingenuity"—the trait that permits Radioman to both promise *and* deliver the customized, odd, offbeat, crazy, screwball, zany and unusual applications for radio communications and related systems that are so needed by public safety agencies and private users alike.

As the contemporary needs of public safety users continue to evolve and expand, we are more frequently met with a rebuttal barrage from the "factory man" from the Major Firm that we don't really know what we need, and a new digital system from the Major Firm will solve our problems.

I'm discouraged by this blanket response but cognizant of several of the contributing factors. First, the product focus of most Major Firms is constantly following (or chasing) market forces, which, themselves, are driven by mass merchandising and commoditized wireless communications. Translation: conventional public safety products aren't a Major play. (It's only by selling expensive public safety products that this is even a viable market.)

Second, the direct sales force of many Major Firms is being re-re-reshuffled in light of two-way radio product sector profitability. Translation: See your *local* shop for sales and support—*we're* only working on really B-I-G systems for important customers.

So, again, the irrestible force of evolving needs and growing service demands meets the immovable object of mass-merchandising mindset. What, indeed, is a fellow to do? Simple—put on your thinking cap and roll out the Yankee ingenuity. Don't fall victim to the implied philosophy that "If we don't make it, your agency doesn't need it." No, single-product systems aren't a good idea, but, yes, simple-concept *systems* work great.

The solution is back to the problem: communication. It's time for

Dunford, *MRT's* public safety consultant, is technical services consultant for the Lenexa, KS, police department. He is a member of the Association of Public-Safety Communications Officials–International. [You can email Dunford at mrt@intertec.com]

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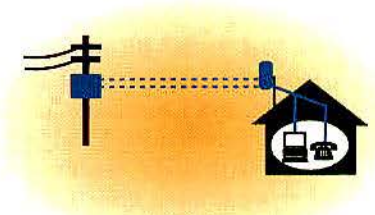

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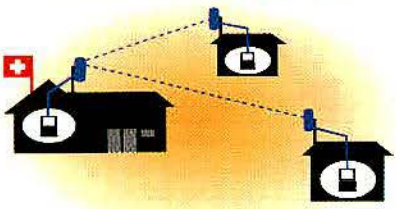

Connects to and extends existing WAN/LAN networks to other sites within 14 km line-of-sight distance. Can also provide wireless broadband Internet and voice-over-Internet (VoIP) to rural areas.

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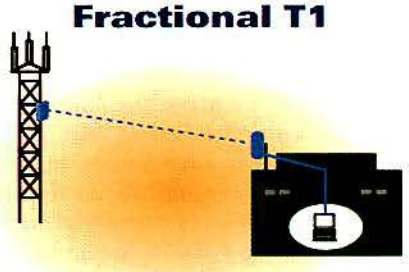

Transmits V.35 synchronous data between two sites for cellular backhaul or other point-to-point digital transmission. Uses just two watts and costs less than the competition.

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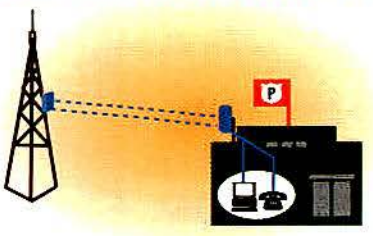

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shop managers and Radioman to stick their noses into the collective public safety communications business—again. Check out current operations. Ride along in the comms center. Buy a cup of coffee (I suggest decaf) for the center manager. In short, stay in touch, or the Major Firms will short-circuit your local contacts and good judgment.

Two good places that pique my interest and offer perspective-broadening experiences are the IWCE show and the APCO conference. Not only is there a select crop of technical peers at each gathering, but vendors from small to Major Firms have comprehensive product displays and demonstrations. Given increasingly specialized product lines, talking one-on-one with the maker's technical staff is the hot setup.

Which brings us to the "build it" phase of project work. I was visiting with Ted "Lefty" Bleiman, my good friend who co-owns MDM Radio in Chicago, and I related to him a delightful conversation I had just concluded with *MRT* reader Richard Neier, a technical investigator with the IRS. Richard was working on a cross-channel repeater project. Being a technical sort, he knew what he wanted to do and wasn't afraid to go shopping for an answer.

Ted, having the world's largest commercial collection of radios, radio artifact, and general radio hardware, parts, and junk, is an eminent authority on finding things with which to construct about any wireless-related project.

Ted and I agreed that the willingness to experiment, build and develop custom (formerly called "ho-made") solutions was waning. Then we spent a few golden moments strolling down memory lane past earlier technology systems and hands-on gadgeteering. We concluded that two-way shop staffs and Radioman are an inventive and ingenious lot.

I recommend taking one of these curious creatures along on your next visit to the public safety comms center. He may well spark the conversation with a good idea and the Yankee ingenuity to get it built. ■

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An exercise in goodwill

After the Ontario government forced six Canadian cities to consolidate into Toronto's infrastructure, the next challenge was merging police and fire networks.

By James Careless

Consolidation of multijurisdiction radio communications can be a tricky business, fraught with political, territorial and technical issues. Who would have guessed that the merging of Toronto's metropolitan area police and fire networks could generate *goodwill*? So much goodwill, in fact, that the city's ambulance service would plan to join them as well.

That is exactly what happened when Toronto's police and fire departments decided to merge their 800MHz networks and share facilities a couple of years ago, said Dan Perlstein, program manager of wireless networks for Toronto Police.

"It was an amazing experience, the amount of goodwill and good wishes from both services, as they came together," Perlstein said.

When Toronto's metropolitan-area communications systems merged, the usefulness of backup control centers was extended to include training activities.

Only a few years ago, what is now Toronto was actually six discrete cities, each with its own police and fire departments.

However, in a bid to reduce its municipal transfer payments, the Ontario provincial government forced the six cities to merge in January 1998. Toronto is now Canada's largest city—more than four million people call it home.

To enable its mission to keep the public safe, the Toronto police use about 5,000 Motorola analog and digital radio units in the field. The Toronto Fire Department deploys about 1,000 Motorola radios, and Toronto EMS uses about 350 Ericsson radios. The city's public safety networks broadcast from 16 towers over a range of 70 frequencies.

The seven original police departments had already consolidated communications into a multijurisdictional radio network before the great municipal merger. The fire departments, however, were still maintaining separate radio systems.

For the fire departments, the big question was how to combine networks while maintaining their quick response time. Meanwhile, the Toronto police department was busy redesigning its networks so that it could add mobile data communications.

"As it turned out, the opportunity was there to work with another public safety department

Careless is a freelance telecommunications journalist based in Ottawa, ON, Canada. His email address is james@tjtdesign.com.

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which was in the midst of doing similar things," Perlstein said.

"We were supposed to trunk a number of frequencies to gain more capacity. They were supposed to amalgamate their various systems and trunk them as well," he said.

The combining of the cities wasn't the only cause for the police and fire departments to work together. The lack of immediate redundancy for Toronto-area 9-1-1 service also spurred the merger.

"Before the amalgamation, the police were handling Toronto's 9-1-1 service," Perlstein said. "Should that service go down, or the building be evacuated, the procedure was that we would bus our people to our backup control center."

PSAPs and preparedness

Performing such a transfer could take up to an hour, though, during which time Toronto would be *without* a backup 9-1-1 service.

Faced with this situation, the Toronto Police Department began to wonder if there was a way to create a "hot backup"—one that would allow them to keep 9-1-1 operating, no matter what happened.

The answer turned out to be cooperation with the Toronto Fire Department and Toronto EMS. Between them, these two services had enough radio staff to provide a meaningful backup, Perlstein said.

The result was that the TFD and Toronto EMS agreed to jointly provide a "hot-switch" backup for Toronto Police 9-1-1. There would be no more hour-long waits. Whatever happened, Toronto was covered.

Joint training facilities

The next step in this consolidation was the use of the backup control centers as training facilities.

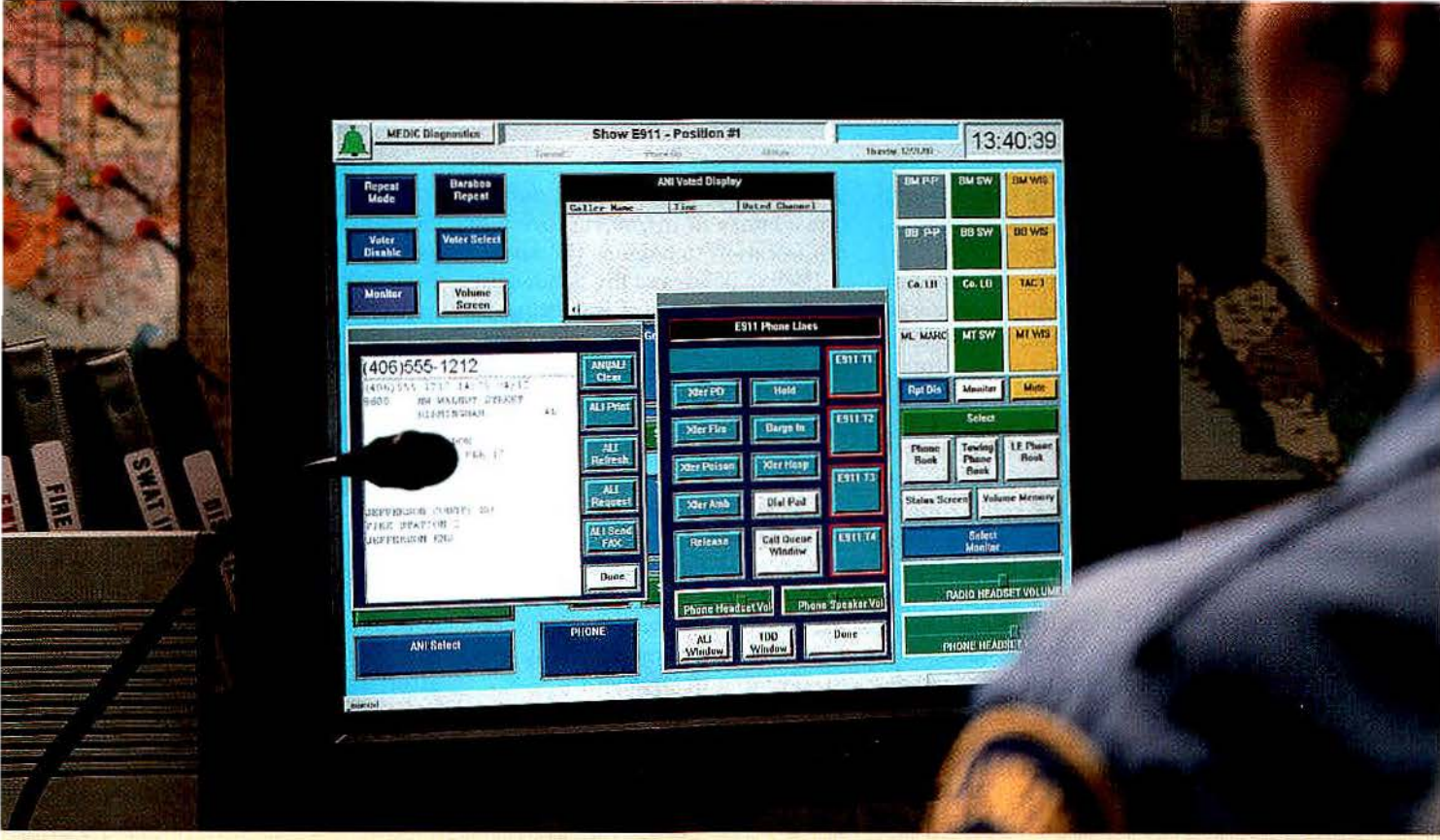
"We're training, the fire department is training, and the ambulance service is training," Perlstein said. "So I figured, 'Why don't we use these backup control centers as training facilities?'"

From there, it was a short step to merging three networks into one. If one of three services lost its dispatch center, the other two would cover for it while its backup center was being activated.

Consolidation conflict

Currently, Toronto Police and Fire are working jointly using Motorola technology. Although Toronto EMS is committed to consolidation, its current Ericsson infrastructure inventory is said to prevent it from doing so.

"Their radios are just about due for replacement," Perlstein



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said. "We're working with them to figure out their needs, so that we can all work together."

It wasn't simple to amalgamate Toronto's police and fire networks. For one thing, the two departments had to coordinate their response areas so that the joint network would serve fire and police equally. "The main issue here is that it's got to be a win-win situation," Perlstein said.

'We've already saved the city $5 million in capital costs by running an integrated network,' Perlstein said.

There was also the issue of *who* would run *what*. As it turned out, the Toronto Police Department already had a large maintenance facility, so the department took responsibility for maintaining and supporting the physical plant. Meanwhile, the TFD took on the lion's share of infrastructure administration to balance the load.

Pooling police and fire bandwidth was another area of cooperation. "We chipped in a number of frequencies consistent with our traffic, and they did likewise," Perlstein said. The same was the case for towers; everyone shared what they had.

The final issue was "culture." Anyone who has been around police and fire employees know that the two operate in separate worlds, with different ways of doing things. Making the two meet was no easy task. However, goodwill went a long way in solving these problems.

Savings through efficiency

Since Toronto's police and fire departments starting working together a year ago, the savings have started piling up.

"We've already saved the city $5 million in capital costs by running an integrated network," Perlstein said.

It used to cost about $700,000 a year to run both departments' radio networks. Today, the price range is closer to $345,000 to $415,000 annually, including the improvements in 9-1-1 efficiency.

Commitment to consolidation

This amalgamation resulted in better service and lower costs. It didn't cause friction between its partners. No one is more amazed that Dan Perlstein. Even a year after the event, he can't believe how well it has all gone. What has been a nightmare elsewhere has proven to be a dream in Toronto.

"There was a lot of willingness on all sides to make this work," Perlstein said. ■

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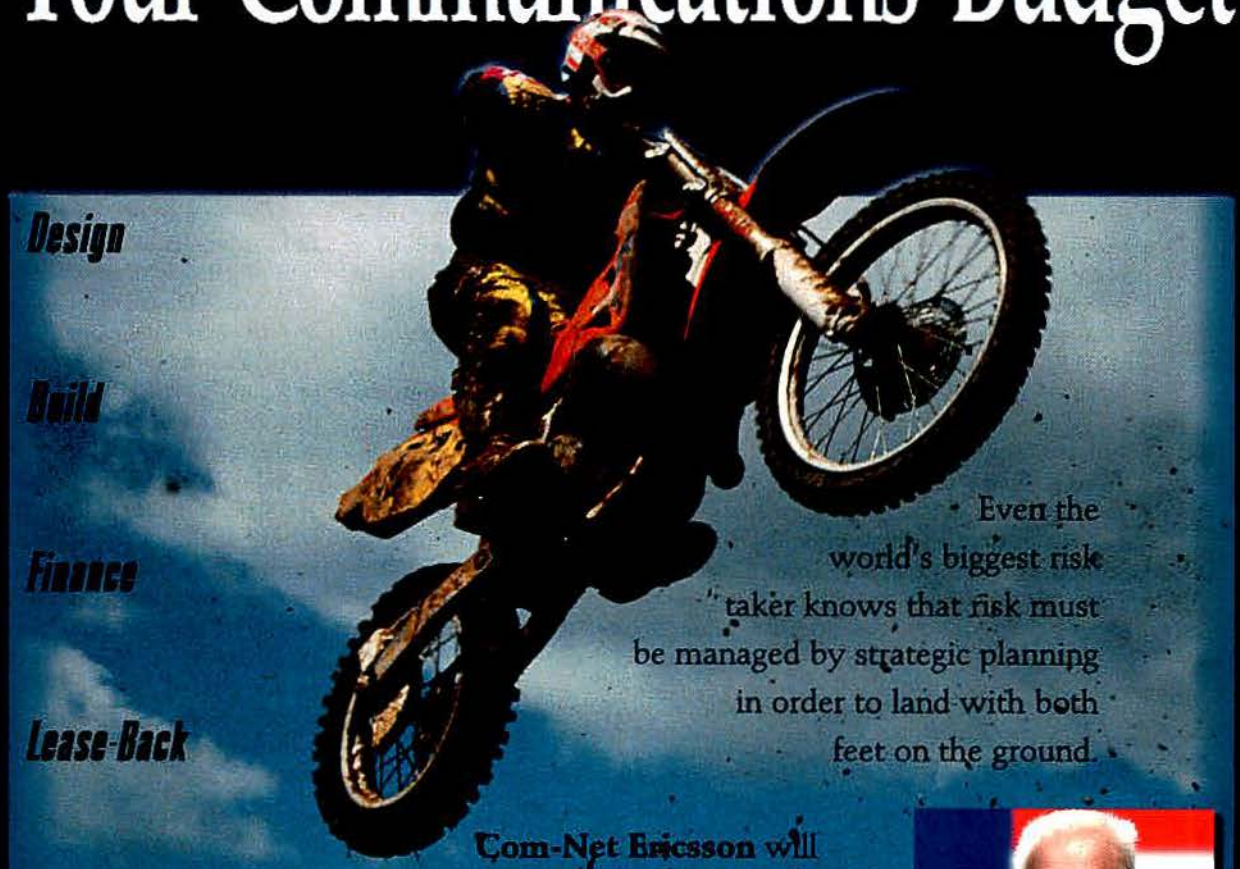

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Using and converting RF units of measure

By Harold Kinley

Many RF measuring units, as well as various *forms* of those measuring units, are in use today.

It is important to understand what the measuring units mean and how they are used. It is also important to remember that the decibel is a *relative* measurement unit unless it is based on an *absolute level.*

For example, "6dB" does not tell us the absolute level of a signal. But "+6dB*m*" *does* because it is referenced to an absolute level.

Field strength/intensity

Field strength or *field intensity* is an indication of the strength of the electromagnetic field present at an antenna or at a distance from an antenna. Generally, communications technicians refer to field intensity as a measure of volts per meter (V/m) and more often as microvolts per meter (μV/m).

POWER	×	125%	=	+1dB
POWER	×	160%	=	+2dB
POWER	×	200%	=	+3dB
POWER	×	1000%	=	+10dB
VOLTAGE	×	125%	=	+2dB
VOLTAGE	×	160%	=	+4dB
VOLTAGE	×	200%	=	+6dB
VOLTAGE	×	1000%	=	+20dB

Quick power and voltage decibel conversions.

To avoid diving into a deep mathematical presentation, I'll demonstrate the important part of the use of these field-intensity measurements as a practical matter.

How much signal level does a field intensity of 1μV/m produce across the input to a receiver (assuming a 50Ω system throughout)? Assuming that the antenna gain is 0dBd (0dB as referenced to a dipole) then a field intensity of 1μV/m at the antenna will produce a signal level of 1μV across the antenna terminals.

If there is no line loss, then the same level, 1μV, will appear across the receiver input terminals.

This relationship is true *only at a frequency of 40MHz.* At other frequencies, this 1:1 relationship changes. At other frequencies, the signal level at the receiver input must be adjusted according to the formula:

$$dB = 20 \log \frac{40}{F}$$

where F = frequency in MHz and dB is the correction factor in *decibels per meter.*

To calculate the signal level at the input to the receiver, we must take the antenna gain and the line loss into consideration.

For example, given 1μV/m of field intensity at the antenna on an operating frequency of 40MHz, an antenna gain of 3dB and a line loss of 2dB, the input to the receiver will be 1dB above 1μV (antenna gain minus line loss), or 1.12μV.

Now, if the operating frequency changed from 40MHz to 160MHz, with all other things being equal, the input to the receiver would be reduced by a factor of −12dB. So, the receiver input level would be 12dB *below* 1.12μV, or 0.28μV. Because −6dB represents a voltage change to 50% of the *initial value,* then −12dB represents a voltage change to 25% of the initial value.

This correction factor is caused by the change in *antenna factor.* Antenna factor is *frequency dependent.* It can be a negative or positive value, or it can be zero.

At *about* 40MHz, the antenna factor (for 50Ω antennas) is zero. Above 40MHz, the antenna factor is negative. Below 40MHz, the antenna factor is positive.

Another unit of measurement for field intensity is *dBu.* The definition of dBu is "decibels referenced to 1μV/m." Therefore, +6dBu would be 6dB *above* 1μV/m, or 2μV/m, and −6dBu would be 6dB *below* 1μV/m, or 0.5μV/m. The advantage of using dBu instead of μV/m can be demonstrated in the following example.

Suppose the field intensity of a 160MHz signal is 12dBu at an antenna, with a gain of 6dBd, connected to a receiver through a transmission line with 2dB loss. At 160MHz, the antenna correction factor is −12dB. So we add the antenna gain of +6dB and subtract the line loss (−2dB) and the antenna correction factor (−12dB) to get a final value of:

$$+12 - 12 + 6 - 2 = +4dB\mu V$$

or 4dB *above* 1μV. In terms of voltage, an increase of 4dB represents an increase of about 60% over the reference voltage level.

So, the input signal level at the receiver is 1.6μV.

Quick dB estimations

The rules shown in the table at the left can help when trying to mentally calculate decibel conversions to and from voltage or power levels.

We know that a 25% increase in the *power* level is about equal to a 1dB increase, and a 25% increase in the *voltage* level is about equal to a 2dB increase. A 60% increase in power is roughly equal to a 2dB increase, and a 60% increase in voltage is roughly equal to a 4dB increase. A doubling of the power is equal to a 3dB increase, and a doubling of the voltage is equal to a 6dB increase. Likewise, a tenfold increase in power is equal to a 10dB increase, and a tenfold

Contributing editor Kinley, *MRT's* technical consultant and a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is the author of *Standard Radio Communications Manual, with Instrumentation and Testing Techniques,* which is available for direct purchase. Write to 204 Tanglewylde Drive, Spartanburg, SC 29301. Kinley's email address is hkinley@home.com.

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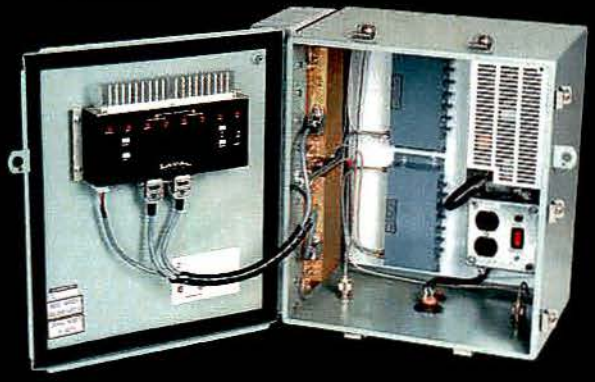

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increase in voltage is equal to a 20dB increase.

Using these basic numbers from memory, we can closely estimate any conversion to and from decibels, to and from voltage, or power level changes.

Now, suppose that we need to convert a 125dB increase in voltage and that the initial voltage is 0.25μV. For each 20dB increase, there is a 10× increase in voltage. Within 125dB there are six 20dB changes, so there would be $10 \times 10 \times 10 \times 10 \times 10 \times 10$. To account for this, we could simply move the decimal point six places to the right to make the voltage equal to 250,000μV.

That leaves 5dB. Now, 6dB would be a doubling of the voltage to 500,000μV, but we are 1dB short of that. Remember, a 2dB increase in voltage was equal to a 25% increase, so a 2dB decrease would be equal to 1 ÷ 1.25, or 0.8 times the reference voltage. So, we can linearly interpolate to arrive at 0.9 as the multiplication factor for a 1dB decrease. Therefore, multiplying 500,000 × 0.9 = 450,000μV. Now to check our calculations we run the formula:

$$dB = 20\log\left[\frac{450{,}000}{0.25}\right] = 125.1dB$$

So, our estimation missed by only one-tenth of a decibel.

Suppose that we need to increase our power level by 32dB over the current level of 5W. What multiplication factor would we use? Well, 30dB would be 10 × 10 × 10, or 1,000, and the additional 2dB would be an increase of 60%. So the final multiplication factor is 1,600. Now, 1,600 × 5 = 8,000W. Check this out with the formula:

$$dB = 10\log\left[\frac{8{,}000}{5}\right] = 32.04dB$$

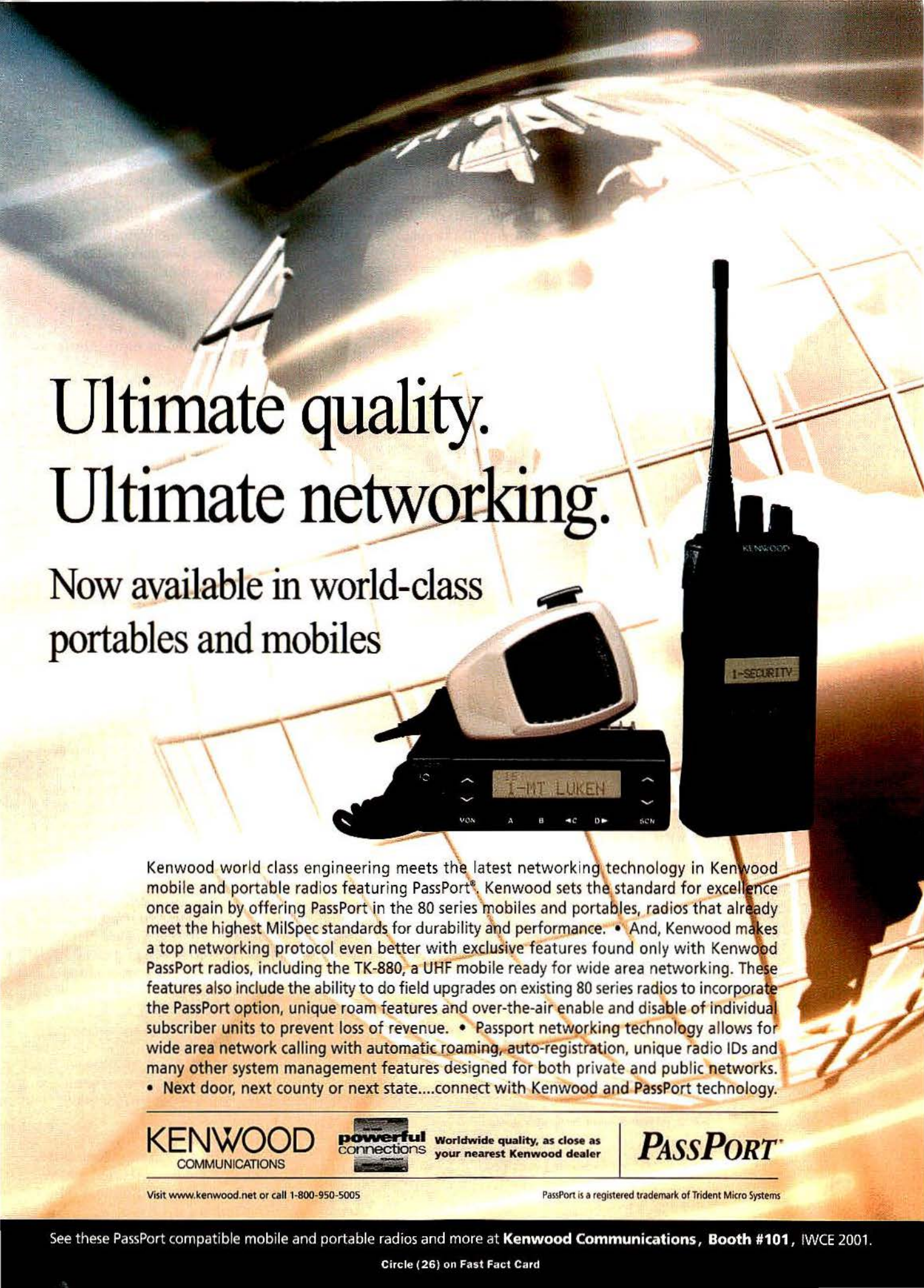
Our estimation was close—close enough for our practical purposes.

Converting dBm to μV

Many times, receiver sensitivity or signal levels are stated in terms of *dBm* instead of microvolts (μV). The term "0dBm" refers to "1mW in 50Ω." To change this to voltage level, simply use the formula:

$$E = \sqrt{P \times R}$$
$$= \sqrt{50 \times 0.001}$$
$$= \sqrt{0.05}$$
$$= 0.223607$$

or 223,607μV. This is the voltage level required to produce 1mW of power in a 50Ω load. It is almost a *quarter of a volt*. It is easier to remember one-quarter volt than



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223,607μV. If we used 0.25V as the 0dBm reference voltage, we would be in error by less than 1dB. So, if we wanted to convert 0.35μV to dBm we could do the following:

Multiply by a factor of 10 until we approach the 0.25V (250,000μV) point and add 20dB for each factor of 10. This $10 \times 10 \times 10 \times 10 \times 10$ progression, would yield 35,000.

Now, multiply by a factor of 2 to approach 250,000: $35,000 \times 2 \times 2 = 140,000$. Another increase of about 80% to get to 250,000 would add another 5dB. (Remember, 4dB is a voltage increase of about 60%, and 6dB is a voltage increase of 100%. So for 80% we linearly interpolate to get 5dB.)

Now, we add the equivalent decibels for each multiplication factor used. We had five 10s, two 2s and an additional 80%, or 1.8, increase, so:

$$5 \times 20\text{dB} + 2 \times 6\text{dB} + 5\text{dB} = 117\text{dB}$$

Thus, 0.35μV is equivalent to −117dBm.

It takes longer to write about it than to do it. This calculation has a margin of error of about 1dB.

Conversely, to convert dBm to microvolts follow this example:

Convert −110dBm to microvolts. Start with 0dBm = 0.25V, or 250,000μV. Now, for each −20dB, move the decimal point one place to the left. Moving five places to the left, we get 2.5μV. Now, six more decibels would yield a level of 1.25μV. Another 4dB reduction would be a multiplication factor of $1 \div 1.6$, or 0.625, to yield:

$$1.25 \times 0.625 = 0.78\mu\text{V}.$$

This is also accurate to within 1dB.

Calculating ERP

It is easy to work with power levels in *dBm* by remembering that 100W is equal to 50dBm. It is easy to calculate ERP by using dBm units for power measurement.

For example, say a transmitter has an output of 100W and a line loss of 2dB. The bandpass cavity has an insertion loss of 1dB, and the antenna has a gain of 6dB. What is the effective radiated power?

First, 100W is equal to 50dBm. Now, we simply add the gains and losses of the transmitter chain to get the ERP:

$$+50 - 1 - 2 + 6 = 53\text{dBm}$$

Because 50dBm = 100W and the level is 3dB greater, we multiply 100×2 to get an ERP of 200W.

The dBW

The term *dBW* means "decibels referenced to 1W in a 50Ω load." A 0dBW signal equals +30dBm, and 0dBm

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is equal to −30dBW. So, just remember to add 30 to the dBW figure for the equivalent dBm figure. Conversely, subtract 30 from the dBm figure to get the dBW figure. In the previous example, the ERP of 53dBm would be 23dBW. To convert to watts, 20dBW is 20dB above 1W. The increase would be 100 × 1W to get 100W, and then the additional 3dB would double the power to 200W.

Using dBμV

The *dBμV* unit of measure is occasionally found. It simply uses 1μV as the reference level. A level of +6dBμV is simply 2μV because 2μV is 6dB above 1μV. Conversely, −6dBμV is 0.5μV. Do not confuse dBμV with dBu. They are not the same, although sometimes the term dBu is *erroneously* used to mean dBμV. Watch out for that error.

The dBc

The term *dBc* is used to refer to a signal power level as "so-many decibels referenced to the carrier." To be accurate, the proper value sign—almost always negative—should precede it.

For example, suppose the level of a spurious signal is stated as −95dBc. This means that the carrier power is the 0dB reference level and that the spurious signal is 95dB below the carrier level.

Suppose that the carrier level is 100W or 50dBm. Then the spurious level is at −45dBm. This is an absolute measurement.

The dBd versus dBi

Watch out for the antenna gain specifications from some manufacturers. The antenna gain specification for land mobile radio work should be stated in *dBd*, that is, "gain in decibels as referenced to a dipole antenna."

If you see the antenna gain stated in terms of *dBi*, you can convert it to dBd by subtracting 2.15 from the stated gain. In other words, an antenna gain of 2.15dBi is equal to a 0dBd gain. The "i" signifies *isotropic* radiator, a theoretical spherical antenna that radiates equally in all directions from the center of the sphere. Using the isotropic radiator as a reference makes the antenna appear to have more gain. Don't be fooled.

You can convert RF measurement units as long as you follow a few simple rules—if you know the reference on which a unit of measure is based. With a little practice, you can make quick mental conversions and get pretty close—at least close enough for our purposes as communications technicians.

Until next time—*stay tuned!* ■

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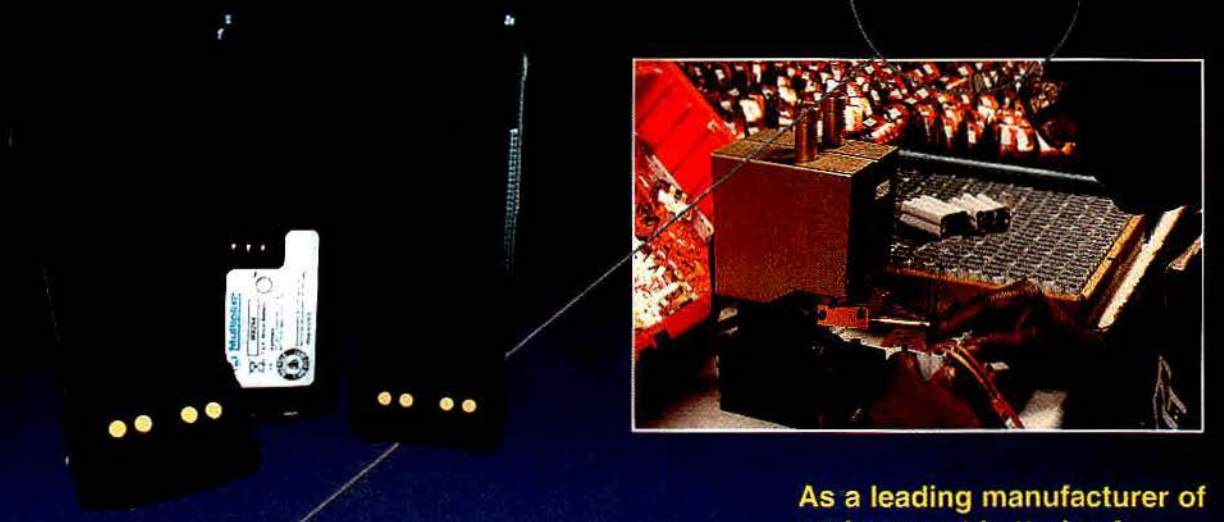

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When Lonnie Danchik looked for a business strategy to continue to grow as a commercial radio service provider in the Dallas metropolitan area, he saw a range full of 800MHz and UHF wranglers. His solution: Try the VHF narrowband trunking brand.

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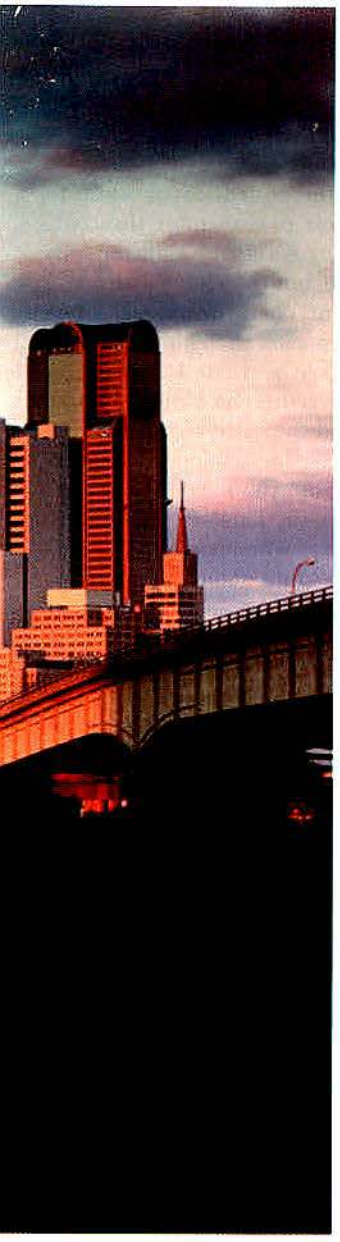
Texas is cowboy country, and every good drover knows that you have to keep your herd moving. If you don't, you'll never get to the market. It also helps to constantly improve your breed.

For nine years, Lonnie Danchik has been looking for new opportunities to keep growing his CommNet Communications operation in the Dallas–Fort Worth metroplex. He sells equipment, provides dispatch radio, installs and services, and resells paging, cellular, PCS and ESMR. Danchik keeps looking for the "next good thing" to differentiate his herd, such as fleet management, mobile data, computer-aided dispatch or GPS/AVL. In the process, CommNet has become the largest independent SMR trunked-system operator in the city. *[For Danchik's viewpoint on the challenges facing dealers, see "Point-of-Sale Perspective" on the back page.]*

Changes across the land-mobile prairie, including spectrum scarcity and the domination of 800MHz by a few coyotes, caused Danchik to reexamine his market, to review FCC rules changes and to reevaluate his business plan. The result: Danchik took hold of the opposite ends of the trunking spectrum "rope," 900MHz and VHF, and lassoed Dallas with it.

The first move, made attractive by the availability of exclusivity, was into 900MHz. However, the



MAKING VHF TRUNKING WORK

By D. A. Keckler

repositioning came with technical challenges in combining and audio quality. CommNet's 900MHz system has the technical bugs worked out and now has mature loading. It generates a nice income, maintains low churn and even picks up "returnees" from ESMR who just want traditional dispatch. But there were still goals that Danchik wanted to achieve for users including better propagation characteristics, simpler and less-expensive mobile installations, and higher-power portables. Looking five years down the road, Danchik saw that FCC "refarming" offered opportunities for UHF trunking, but he held back, based on the lack of exclusivity, fierce competition and interference problems he observed in the Dallas market.

Old breed, new variety

"My goal was to compete with Nextel's dispatch feature—not their phone feature," Danchik said. "I said, 'What technology exists, so that we can *do* that?' What the customer wants is so far away from what we've been able to provide, we've either got to get innovative, or go do something else."

Looking for that something different, Danchik recognized that other refarming changes could create opportunity back at the place where land mobile started: VHF.

The FCC's refarming order, effective at the end of 1997, also authorized trunking in the shared 150MHz–174MHz band, where channels were previously 30kHz wide and spaced every 15kHz. The FCC added *new* interleaved channels *between* each existing channel and promoted a move to narrowbanding down to 7.5kHz bandwidths. Great: new,

Danchik checks the VHF repeaters at the 1,539-foot AMSL McKinney tower, north of Dallas.

Keckler is technical editor.

exclusive channels. However, the order restricted operations to equipment that could operate on channel bandwidths of 12.5kHz or less. *Not* so great: time to wait for the manufacturers to catch up.

By fall 1999, a few manufacturers, including Kenwood Communications, which CommNet selected, were ready to market type-accepted mobiles and portables.

The coordination started smoothly. "In the early days of filing, in the Dallas area, getting the new, narrowband frequencies was actually pretty easy." Using Forest Industries Telecommunications as his coordinator, he was able to process several applications for five-channel blocks throughout the Dallas and north Texas area.

The situation was rosy—*until*—the larger coordinator camels stuck their noses under the tent. Frequency Advisory Committees cooperate, but they have also been, to be blunt, *competitors* ever since the FCC pooled their jurisdictions.

Some FACs started inspecting and criticizing the work of other FACs, and they also began alerting their VHF clients to possible interference from the new VHF trunking licensees. This set off a flurry of radio hypochondria, often eliciting complaints about interference received from systems that had not even been constructed yet.

2000: Year of decision

When the dust settled, in mid-2000, two issues were decided: First, operators like Danchik got the coordinators to back off from inflammatory statements that implied that new licenses are not in compliance with the FCC rules.

Second, all the FACs agreed to solve the controversy by treating *adjacent-channel* frequencies just like *co-channel frequencies,* which means to get a VHF trunking frequency now, concurrence has to be obtained for a 39dBu (70-mile) contour from co-channel *and* adjacent-channel incumbents. This will impede, though not entirely restrict, the possibility for new systems in urban areas.

Danchik was already managing about 50 channels before the cow pie hit the fan. He has added 13 more, to date, by accepting difficult coordinations—mixing exclusive channels with shared frequency, non-interference-basis channels. "We take them to fill," he said.

Operators wanting to deploy new VHF trunking in major urban areas will now have to run a longer gauntlet, but there are frequencies in markets where VHF hasn't caught on yet, and there are still plenty of VHF frequencies available in rural markets.

So, with the initial coordinations, and the fill-in channels set up to monitor and handle any interference, CommNet's framework

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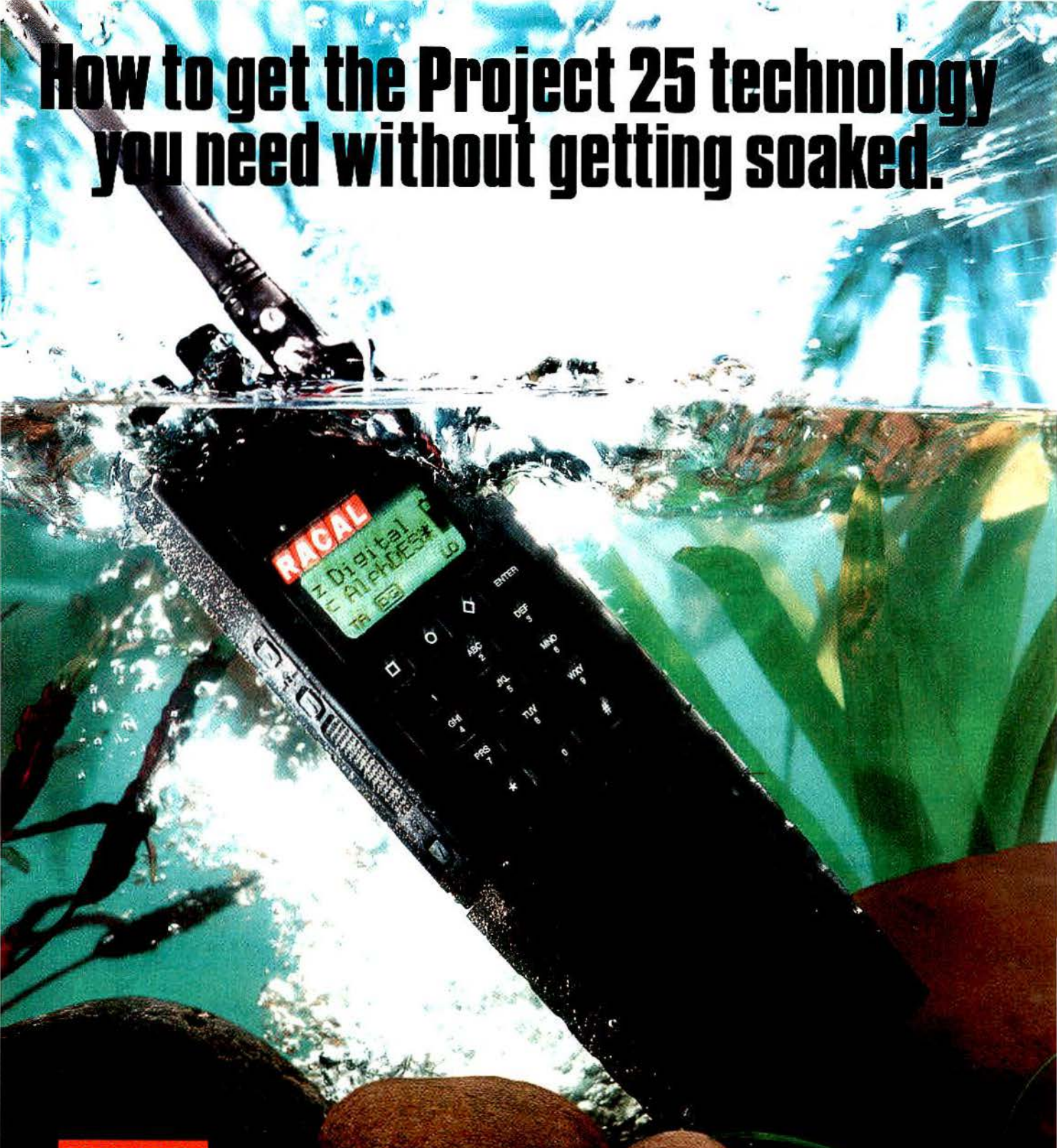

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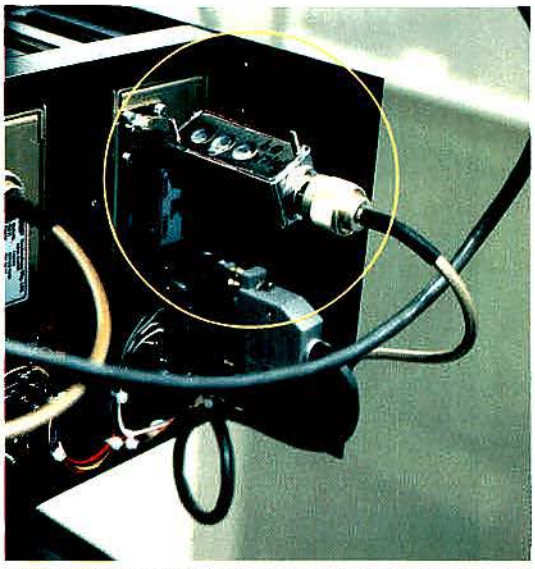
was in place. But, as with 900MHz, there were technical hurdles.

Fences across the range

Channel pairing was the first stumbling block. With few exceptions, no natural pairings exist in the VHF bands. Danchik asked



A crystal filter, mounted in-line with the receiver, turned VHF narrowband trunking into a viable service.

FIT to try for about 5MHz of separation, transmit to receive, and at least 250kHz between transmits.

The second hurdle was the capability of the newly available equipment. Although all the VHF frequencies are being assigned at the 7.5kHz split, the available manufacturers' receivers are, at a *minimum,* 7.5kHz narrow. "Sometimes at 15kHz over, there's some 400W and 500W paging channels out there." Danchik said. "This has caused us a real problem because you do have combining, duplexing, and multicoupling."

The biggest problem encountered was talkback capability. Talkout was "absolutely wonderful," but the LTR radios weren't getting the handshake to go ahead. Not only the portables, but even 25W mobiles with 3dB antennas, were being difficult.

"So we asked, 'What's going on?'" Danchik said. "You go back to the site, get your spectrum analyzer, you look at the noise floor, and you begin to see there are paging channels, there's all sorts of VHF, there's God knows how much unlicensed stuff running around there. They're all over the place, and no one's receivers are tight enough to eliminate this."

CommNet's repeater supplier, DX Radio Systems, finally came up with the solution: a narrow, crystal receiver filter. "You order it specifically to your exact frequency, you tell them you want it to be a 7.5kHz window, and you put it right on the front end of your receiver. That's the *good* news," Danchik said. "The *bad* news is they cost $400 dollars apiece. So, if you've got a five-channel system, you just spent another $2,000 you weren't planning on spending."

Delivery time for the precious solution also became problematic. "You can imagine what must have happened at these crystal filter manufacturers," Danchik said. "They were probably selling 10 a year of these things, and all of a sudden they had orders for hundreds of them." Four-week delivery time soon became a 16-week backlog, but "We had finally managed to get them and put them on, and that's been a big, big difference," Danchik said.

One system that was constructed, but not loaded, was used for a customer demonstration just as the solution was being worked out. The prospective client wanted to switch back from ESMR to traditional dispatch, looking for portability in a clear system—that wasn't one-to-one and wasn't cellular—and would cover Dallas. The sale hinged on the demo.

Danchik approved the demo use of one channel. "They're not going to trunk anywhere," he told his staff, "because there's nobody else on the system anyway. Let's see how that works for them."

He decided to monitor the demo from his office.

'They're not going to buy this'

On demo day, the prospective client passed out four or five portables to its field crew, and by midmorning Danchik was gloomy. "They were talking on it, and I'm listening to them. About half the transmissions were OK, about half were less than OK. Some of them were *crappy,* quite frankly." The users were also making unfavorable comments: "I don't think this is going to work for us, you're not too clear."

"So, I'm sitting there listening to them, and I was shaking my head, saying 'This *isn't* going to *work*. They're *not* going to buy this. They're *not* going to be happy,'" Danchik said.

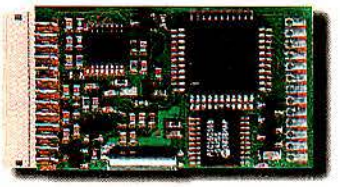
"They'd been demonstrating since 8 o'clock that morning, I'm half-listening to them on the radio while I go about my day's business. About 10 o'clock, my receivables person from the back comes to the door with the inventory list and says 'We just got in the first five crystal filters.' I grabbed my tech and said 'Go put 'em on, go put 'em on. Right *now*—go put 'em on.'

Making things XTAL clear

Fortunately, the users from the company trying the demo went to lunch around noon, while Danchik's technician finished the install. "The conversations that I heard the rest of the afternoon—it just cleared up. It was just night and day. They said 'I don't know what happened. I guess these things have to *warm up* or something.' They ended up buying. They have a base, and they have 20 or so Kenwood VHF narrowband trunking hand-helds. They use them all over the Dallas area. They're *happy.*

"Now, when someone's in my office and I click the radio on, they go 'Wow, what kind of system is *that?*' And I say *that's* our new VHF narrowband trunking system."

The addition of the filters also allowed CommNet to reduce the attenuation settings on the site amplifiers. "We're really pleased with where it's headed. All the channels don't have all of the problems. For some of them, the crystal filter helped, but it's not the final solution. There's a lot of things you've got to do to your sites," Danchik said. That list includes careful antenna matching and using exposed-element antennas.



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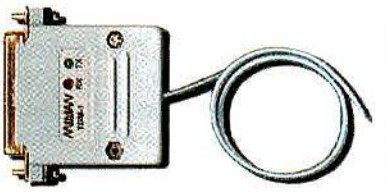

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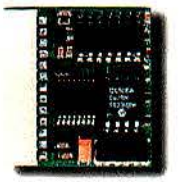

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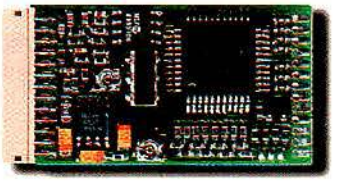

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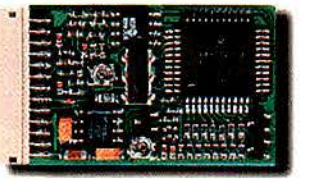

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In addition to using Decibel Products' four-dipole DB224 antennas at its repeater sites, CommNet's VHF narrowband trunking setup includes DX Radio Systems' Millennium series narrowband repeaters and Trident Micro Systems' trunking logic controllers for LTR. The system rings the metroplex with rooftop and tower sites in Dallas, Fort Worth, Richland Hills, Denton, McKinney, Sherman, Greenville, Cedar Creek Lake, and a newly constructed 1,600-foot tower site at Cedar Hill.

For subscriber units, CommNet is exclusively using Kenwood Communications' TK-280 portables and 25W TK-780 mobiles.

"The propagation of VHF is pretty darn good," Danchik said. As an example, he cited one five-channel system he has placed at a rooftop site managed by Retcom/Trott Communications. The site sits atop Dallas' 550-foot Cityplace building, two miles north of downtown. "I'm operating a VHF trunked system there with 100W power, and typically about a 6dB antenna. I'm also operating several 900MHz systems in downtown Dallas on a 922-foot building, where I'm putting out 150W power per channel. The range is as good or *better* on the VHF than it is on the 900MHz, even though I'm 400 feet shorter."

Rounding up customers

"From the perspective of propagation, it's the best we've ever had," Danchik said. "And I've never had a mobile—that wasn't digital—that sounded this good."

Danchik said that although VHF trunking only represents about 5% of current loading of all CommNet's radio customers, in the future it will represent about 75% of loading, exceeding the 900MHz commitment. ■

Global VHF trunking

VHF trunking is finding adherents around the world. SmarTrunk Systems, Hayward, CA, has developed a 52-site SmarTrunk II system for the Estonian Railroad, operating throughout Estonia. All 52 VHF repeater sites will be linked so that the dispatch center, located in Tallinn, will be able to communicate with trains anywhere in the country.

Previously, the railroad had been using GSM phones for communications between the trains and the dispatchers. Working with the local Motorola distributor in Tallinn, SmarTrunk and its Argentinian partner, I-SATEL, designed a system using the I-SATEL ISX-510 switch to link the 52 sites together. Now the crews can talk to Tallinn dispatch, any local station on their routes and any track workers along the way. The system also is capable of telephone interconnect.

The network system is in the process of being installed, and there is a great deal of interest from other Eastern European countries in this low-cost solution to a networked communications system, SmarTrunk said. ■

Ready, set ... *calculate!*

Erlangs? Queuing? Grade of service? Once you know the basics, you can use software to analyze trunked system capacity. Follow these steps to practical capacity planning for your radio system.

By Mark A. Gutowski

If you're involved in the design or support of land mobile radio systems, you've probably heard of the "three Cs": *coverage*, *capacity* and *cost*.

Designers typically try to meet coverage requirements by strategically locating sites, optimally specifying and configuring antenna systems, and controlling transmit power and other technical parameters.

System capacity, or the ability of the system to carry user messages, involves quite a different approach.

Of course, improving system coverage or capacity (or both) almost always increases system cost.

Whether you're evaluating a potential new trunked radio system, or operating an existing system, it's important to understand the basics of trunked system capacity.

In effectively forecasting requirements, your goal should be to provide your sites with an adequate number of channels to support peak user load. This will avoid user complaints about "not getting through" or "excessive queuing" and also allow for future expansion of your wireless network. An overall understanding of traffic planning and capacity modeling can also help identify factors that contribute to capacity problems on an existing system.

Basic concepts

Land-mobile radio systems rely on the concept of *trunking* to accommodate a large number of users with a small number of radio channels. It's similar to how a small number of telephone trunk lines connecting telephone central office switches can be shared by a large number of individual users.

System control logic differentiates various trunked system architectures. Two types of trunking include: dedicated control channel (*centralized* trunking) and subaudible signaling control (scan-based or *decentralized* trunking). Com-Net Ericsson's EDACS and Motorola's Smartnet systems use dedicated control channels. Systems using E.F. Johnson LTR technology use subaudible signaling.

In the dedicated control-channel architecture, when the user presses the push-to-talk button, his radio requests a *traffic channel* (or working channel) by sending a message on a control channel for the serving site. If all available traffic channels for this site are in use, the user is usually placed in a *queue* until a channel becomes available. In analyzing trunked system capacity, this queuing process is usually the limiting factor.

Trunking theory definitions

Trunking theory fundamentals are applied to capacity analysis using statistical tools created by A. K. Erlang, a 19th-century Danish mathematician. Today, the measure of traffic intensity bears his name.

One *Erlang* is defined as the amount of traffic intensity carried by a channel that is fully occupied. For example, a channel that is completely occupied for 15 minutes during an hour timeframe carries 0.25 Erlangs of traffic.

The *grade of service* is a common system benchmark that provides a measure of a system's ability to

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Table 1. Performance parameters.

Symbol	Units	Description
GOS	%, s	Grade of service
t	s	Desired queue delay
H	s	Average PTT duration
f	PTTs/s	Average PTTs per second
U		Number of users
C		Number of traffic channels

provide a user access to a trunked system during the busiest hour. The term *busy hour* refers to an arbitrary period but is important because it provides a worst-case result. The actual "busy hour" depends on your particular use patterns over time. For example, an urban SMR operator may specify 5 p.m. to 6 p.m. on Fridays, while the busy hour for a natural gas company using a trunked LMR system may coincide with a 3:30 p.m.–4:30 p.m. shift change on the first Monday of the month.

Specifically, for trunked architectures that support queuing, the GOS represents the probability that any given call experiences a delay greater than a specified *queue time*. A typical system GOS requirement might be stated as follows: "We desire that no more than 2% of our user's call requests, or PTTs, be delayed in a queue for longer than three seconds."

Applying the theory

To create capacity estimates that ultimately determine the number of required channels to support a specified GOS, several performance characteristics need to be provided, as shown in Table 1 at the left.

When designing a new system, these parameters come from:

- estimates provided by mobile users or dispatchers.
- engineering studies or experiments to gather over-the-air statistics from an existing system.
- published industry studies.

The first step in applying trunking theory is to calculate the *offered load per user*—that is, how much traffic, in Erlangs, a given talk group or individual user service generates. Using the parameters defined in Table 1, the offered load per user, A_u, is expressed as:

$$A_u = f \times H$$

As an example, assume a user's average PTT duration, H, is five seconds, and each user, on

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average, PTTs 10 times during the busy hour. Note the extra term below that converts PTTs/hr to PTTs/s:

$$A_u = \left(\frac{1\text{hr}}{3{,}600\text{s}}\right) \times \left(\frac{10\ \text{PTTs}}{\text{hr}}\right) \times 5\text{s} = 0.0139$$

In this example, the user offers 0.0139 Erlangs of traffic to the system. Remember that one Erlang represents a fully occupied channel during busy hour, so this user, if he had his way, would require 1.39% of one channel's capacity during a one-hour timeframe.

For a system that contains U users, the *total offered load*, A, is the number of users multiplied by the offered load per user:

$$A = U \times A_u$$

Assume the example system is a single-site trunked system with 100 users during the busy hour, so the total offered load, A, is simply 1.39 Erlangs. Based on the definition of an Erlang, one could easily (and *incorrectly*) assume that at least two traffic channels would support the offered load.

But recall that one Erlang is a *completely* filled channel; it's unrealistic to have competing users completely occupy a channel. Doing so would require every user to PTT every instant a channel becomes available.

To determine a more realistic channel requirement to support the offered load, an Erlang formula or table is typically used for trunking systems.

The Erlang-C model

In the Erlang-C trunking model, or *blocked calls delayed*, a queue is provided to hold calls that are blocked. When a channel resource is not immediately available, the PTT request may be delayed until one becomes available. The GOS for this model represents the likelihood that a call would be delayed after waiting a specific time in the queue.

To determine the GOS, two calculations are needed. The first is the probability that a call will be delayed, which is derived from the following Erlang-C formula:

$$ErC = \frac{A^C}{A^C + C!\left(1 - \frac{A}{C}\right)\sum_{k=0}^{C-1}\frac{A^k}{k!}}$$

The second formula provides the probability that, once the call is in a queue, the delay will be t seconds:

$$QDelay = e^{\frac{-(C-A)t}{H}}$$

The GOS is merely the product of the Erlang-C probability and the conditional probability, $QDelay$, of exceeding a delay of t seconds:

$$\text{GOS} = ErC \times QDelay$$

Computer programs can readily compute these formulas. To help make capacity analysis easy, I have implemented these calculations into a Microsoft Excel spreadsheet that you can request by email from *MRT* (email: **mrt@intertec.com**). It makes use of Excel's built-in Poisson function, the underlying basis for the Erlang models.

It should be noted that an Erlang-B model also exists to calculate the probability that a blocked call would be dropped. This formula should be used when trunking systems do not use a queue.

Bringing it all together

In the preceding example, a set of 100 users presented a total offered load of 1.39 Erlangs. Assuming the GOS requirement restricts a maximum of 2% of calls to be delayed in a queue for longer than three seconds, the simple calculator portion of the spreadsheet can be used to specify the input parameters (H = 5s and t = 3s) as well as U and f:

Users	Avg dur. (s)	PTTs/user	Offered Load (A Erlangs)
100	5	10	1.389

The spreadsheet calculates the offered load and the corresponding GOS for a range of systems having

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one to 10 channels. The results, shown below, show that, to meet a 2% GOS requirement, four traffic channels are required:

GOS	Channels
175.4%	1
39.4%	2
7.6%	3
1.2%	4
0.2%	5
0.0%	6
0.0%	7
0.0%	8
0.0%	9
0.0%	10

Assumptions

The preceding example, as capacity planning does in general, makes several assumptions. The Erlang models were designed with the assumption that call arrivals will follow what's known as a *Poisson distribution*. A random process characterizes this type of distribution and requires that the times between successive events (or PTTs) be exponentially distributed.

Another key requirement in modeling traffic behavior is to determine an average call transmission length. Statistics gathered from an FCC study (under contract RC10056) support five seconds as a reasonable average transmission length. Your actual average may vary depending on user needs and the actual mix of voice, data and interconnect calls.

One point to remember about traffic analysis, as in many disciplines, is that the results you obtain are estimates of the assumptions that you've provided. The "answer" can only be as good as your assumptions. The more detailed your investigations are to acquire the input parameters, the more accurate your results will be.

Modeling a wide-area system

Estimating capacity for a wide-area trunked system requires special consideration. Several complex, and debatable, factors contribute to user load.

Your initial task should be to determine the quantity of users (whether mobile, portable or fixed) and their anticipated operational service area. For many systems, this can become subjective.

For each system talk group, estimate the number of users, and determine a reasonable estimate for the average call duration, H, and the anticipated number of PTTs per user, f, during the busy hour. The wide-area spreadsheet calculator includes an example, shown in Table 2 on page 48, that lists six such talk group sets for electric and gas divisions in three counties (Oakland, Macomb, and Wayne). The spreadsheet calculates the offered load, A, for each talk group set.

The example analysis is for a fictitious five-site trunked system and includes the Pontiac, Northville, Macomb, Armada, and Howell sites. Under each site in the spreadsheet is a cell to distribute the offered load, as a percentage, from a given source to each individual site.

Talk groups deserve special consideration when analyzing capacity. This is because, unlike in cellular, users of trunked system talk groups can load a site with traffic even if they're just "logged-in" and listening.

The spreadsheet distribution percentages, then, reflect the probability that at least one user will log into that particular site and bring with it the corresponding traffic load of all talk group users for the entire busy hour. Be certain to take overlapping coverage into consideration; neighboring sites will almost always receive a portion of each other's traffic.

Other types of calls that typically load a trunked system

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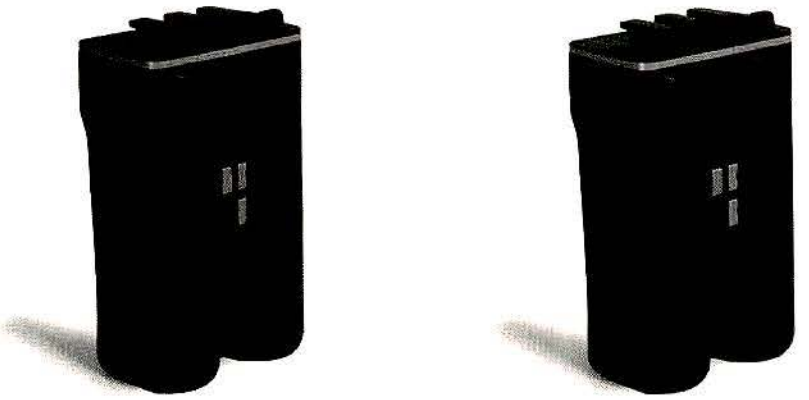

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Table 2. Estimating wide-area system GOS

Talkgroup or traffic source	Users	Avg. duration (s)	PTTs/user	Erlangs (A)	Distribution of traffic among sites (%)					Offered load (Erlangs)				
					Pontiac	Northville	Macomb	Armada	Howell	Pontiac	Northville	Macomb	Armada	Howell
Oakland Gas	40	6	12	0.800	100	90	50	45	70	0.800	0.720	0.400	0.360	0.560
Macomb Gas	20	6	12	0.400	50	50	100	50	40	0.200	0.200	0.400	0.200	0.160
Wayne Gas	25	6	12	0.500	70	100	50	30	80	0.350	0.500	0.250	0.150	0.400
Oakland Elect.	20	5	8	0.222	100	90	50	45	70	0.222	0.200	0.111	0.100	0.156
Macomb Elect.	10	5	8	0.111	50	50	100	50	40	0.056	0.056	0.111	0.056	0.044
Wayne Electric	15	5	8	0.167	70	100	50	30	80	0.117	0.167	0.083	0.050	0.133
Private Calls	10	6	8	0.133	20	20	20	20	20	0.027	0.027	0.027	0.027	0.027
Interconnect	5	25	6	0.208	20	20	20	20	20	0.042	0.042	0.042	0.042	0.042
Data Calls	100	3	20	1.667	20	20	20	20	20	0.333	0.333	0.333	0.333	0.333
								Total (Erlangs):		2.146	2.244	1.757	1.317	1.855

include data, individual and private calls, and telephone interconnect calls. The example in Table 2 includes private call users, interconnect users and data users, who are assumed to be equally distributed throughout the system.

Finally, the spreadsheet sums the offered load for each site to determine the site's total offered load. Table 3, as shown on page 50, then presents a GOS matrix, calculated from the ErC and QDelay equations, for the maximum acceptable queue delay, t, of three seconds.

From the table, we can conclude that to meet or exceed a 2% GOS, there should be six traffic channels at Pontiac and Northville, five at Macomb and Howell, and four at the Armada site.

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Other considerations

Exploring the specifics of your trunked technology (EDACS, Smartnet, MPT-1327 or LTR) may help you to understand how the spreadsheet calculator can be customized for the services and traffic sources of your particular system.

Some areas that require further work to provide a more thorough analysis may include:

- factoring-in call setup time (typically between 250ms and 400ms).
- considering hang time (if used).
- providing data calls to be specified in terms of individual application messages or bytes.
- addressing application-specific packet and network-layer data overhead.

This analysis does not account for two main aspects of capacity. One is that, in dedicated control channel systems, the carrier-sense multiple-access scheme for the control channel itself can limit capacity. The second factor involves the blocking probabilities of central switching and network equipment. Usually, however, unless you're dealing with a large system, user load itself vs. the available channels is the major concern. ■

Table 3. GOS Matrix

	Grade of service				
	Site (Total Erlangs)				
Channels	Pontiac (2.146)	Northville (2.244)	Macomb (1.757)	Armada (1.317)	Howell (1.855)
1	426.9%	473.3%	276.8%	159.3%	309.8%
2	121.3%	137.3%	71.0%	34.7%	81.8%
3	30.9%	35.9%	16.0%	6.4%	19.0%
4	7.0%	8.3%	3.1%	1.0%	3.9%
5	1.4%	1.7%	0.5%	0.1%	0.7%
6	0.2%	0.3%	0.1%	0.0%	0.1%
7	0.0%	0.1%	0.0%	0.0%	0.0%
8	0.0%	0.0%	0.0%	0.0%	0.0%
9	0.0%	0.0%	0.0%	0.0%	0.0%
10	0.0%	0.0%	0.0%	0.0%	0.0%

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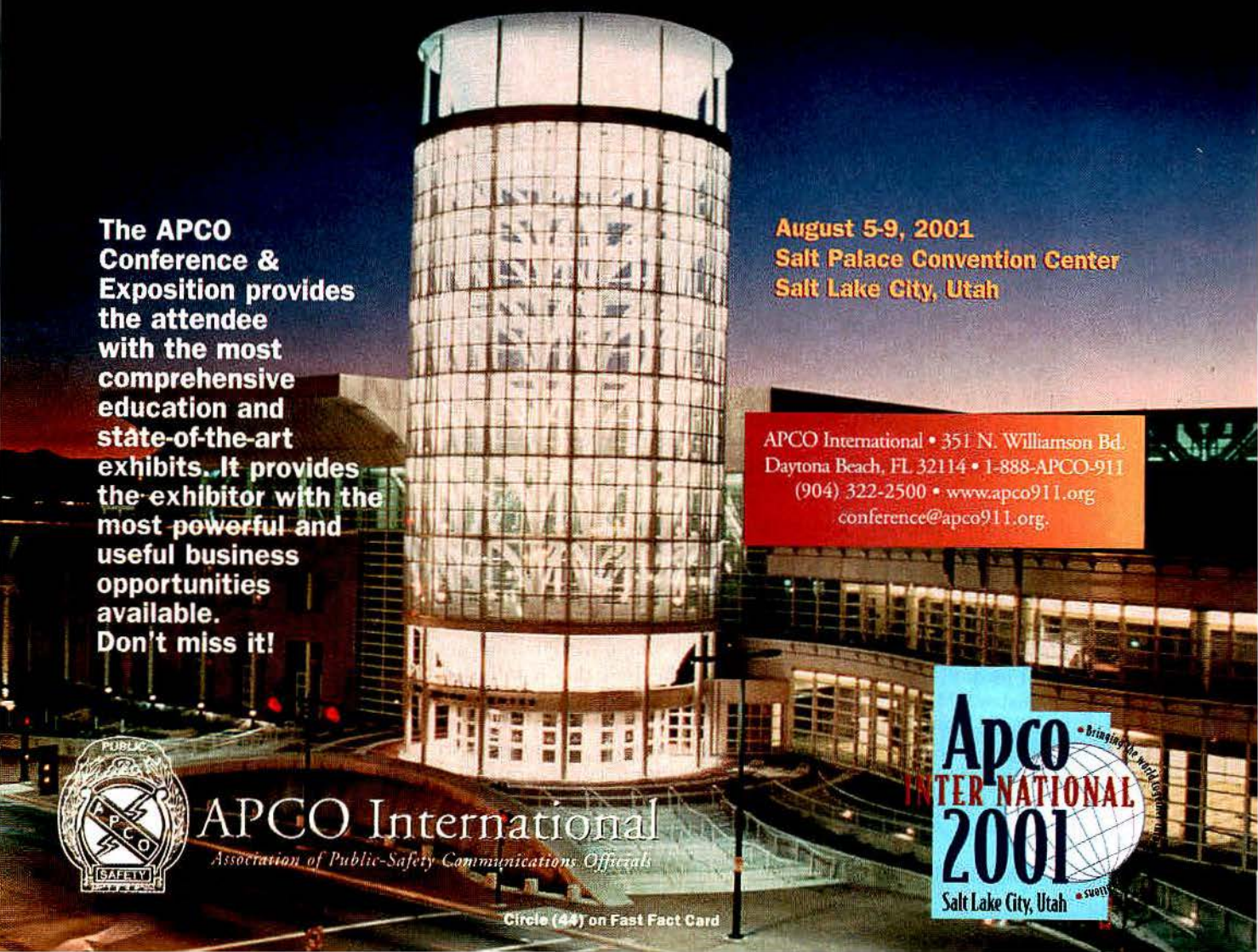

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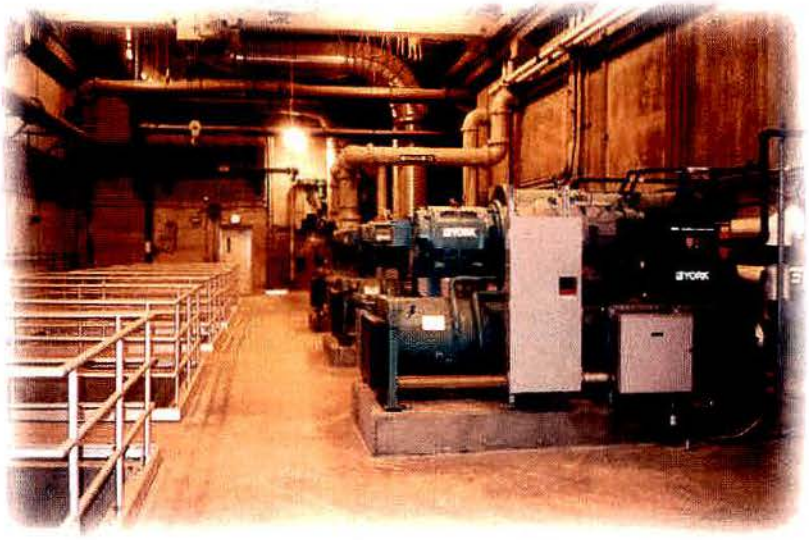
Dual-band in-building wireless networks

Industrial maintenance and safety needs often require multiple communications systems. Getting them to co-exist on one network doesn't have to be costly.

By Steve Blum

Bi-directional amplifiers, or *signal boosters*, offer a fast, inexpensive way to improve in-building coverage for cellular, SMR and PCS service providers. Combining these services onto a single distribution network with BDAs can save thousands of dollars for operators and building owners.



The city of San Diego needed coverage at its new water reclamation facility for its 800MHz city maintenance frequencies and B-band cellular.

Combining PCS and 800MHz services is fairly easy, provided that the components of the distribution network are wideband or dual-band.

Most 800MHz components are wideband enough to accommodate cellular and SMR business bands. However, combining 800MHz cellular and 800MHz SMR BDAs can create a *gain path* between the SMR downlink and the cellular uplink. This will cause an oscillation that will shut down or destroy the BDAs.

The city of San Diego faced such a problem. It needed coverage at its new water-reclamation facility for its 800MHz city maintenance frequencies and for B-band cellular. Most of the facility is situated below grade and is surrounded with thick concrete walls, so no signal was getting through.

A single distribution network would limit the installation cost. The problem is that most bi-directional amplifiers are fairly broadband, as shown in the passband curve graphs on the facing page.

When these units are connected as shown in the accompanying block diagram, a gain path develops at 849MHz and 851MHz.

An SMR 851MHz base transmit signal received by the donor antenna will be amplified in the downlink passband of the SMR band BDA. The two-way splitters have 25dB of isolation, but the cellular-band BDA has at least 70dB gain at 851MHz.

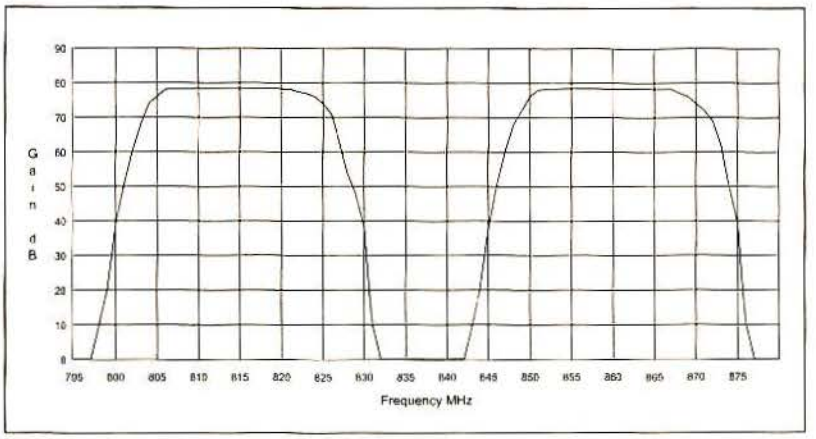
The result is a gain loop with 150dB of gain and only 50dB of isolation. Within a short time, the power amplifiers in both of the BDAs will be overdriven, and, if they lack protection circuitry, they will overheat and fail.

That's the *good* news. If the power amps did *not* shut down or fail, the intermodulation created by the oscillation would cause interference in both bands. Something similar results when a cellular mobile transmits at 849MHz.

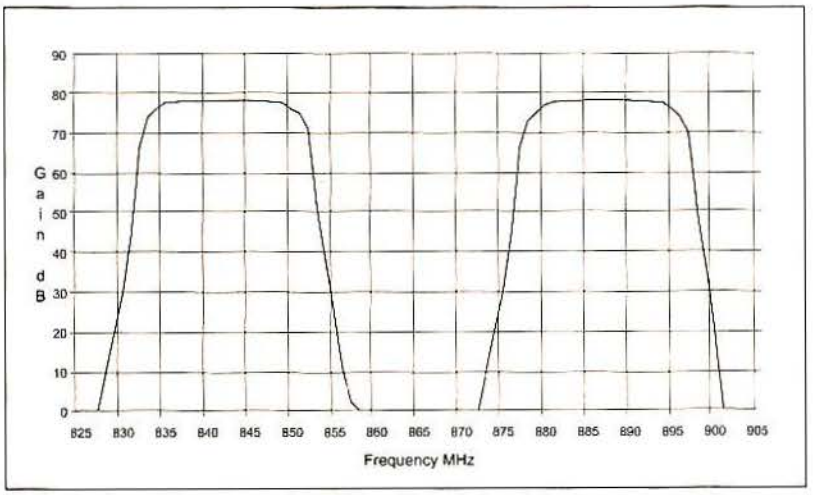
To prevent oscillation, the goal is to provide a level of loop attenuation 20dB above the level of gain at any given frequency (10dB minimum). In this example, 849MHz and 851MHz represent the worse case.

In the installation at the water reclamation facility, separate donor antennas were used. Because the respective base sites were located in opposite directions, separate antennas were needed anyway, and their use provided an opportunity to increase the isolation in the loop.

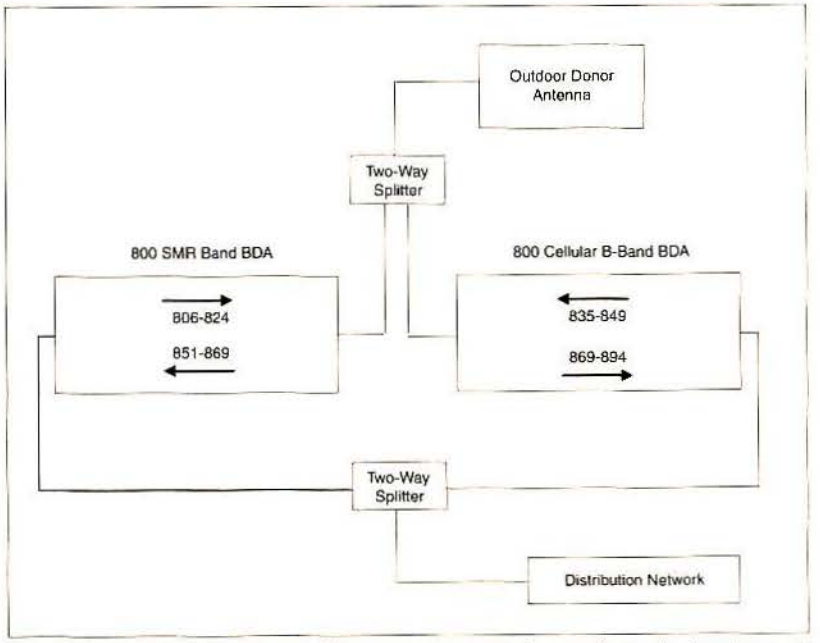
Blum is product manager at Radio Frequency Systems, Meriden, CT. His email address is steve.blum@rfsamericas.com



Typical gain vs. frequency—800MHz SMR booster.

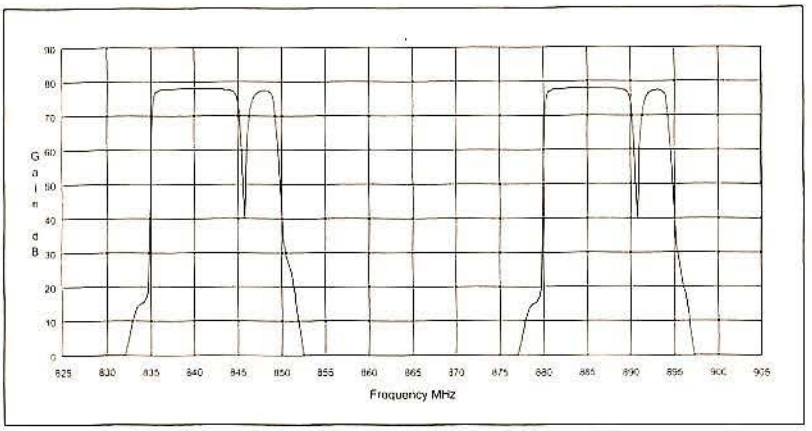


Typical gain vs. frequency—800MHz cellular B-band booster.



When the bi-directional amplifiers are connected, a gain path develops at 849MHz and 851MHz.

Separating the donor antennas by a great distance at the San Diego site was not practical.



Typical gain vs. frequency—800MHz cellular, B-band specific.

Using directional donor antennas is always recommended with BDAs—to increase the desired signal strength and to reduce the potential for interference. Suitable antennas include corner reflectors, yagis and directional panel antennas. Radio Frequency Systems, for example, offers a panel antenna called "Maximizer" with a suitably high front-to-back ratio.

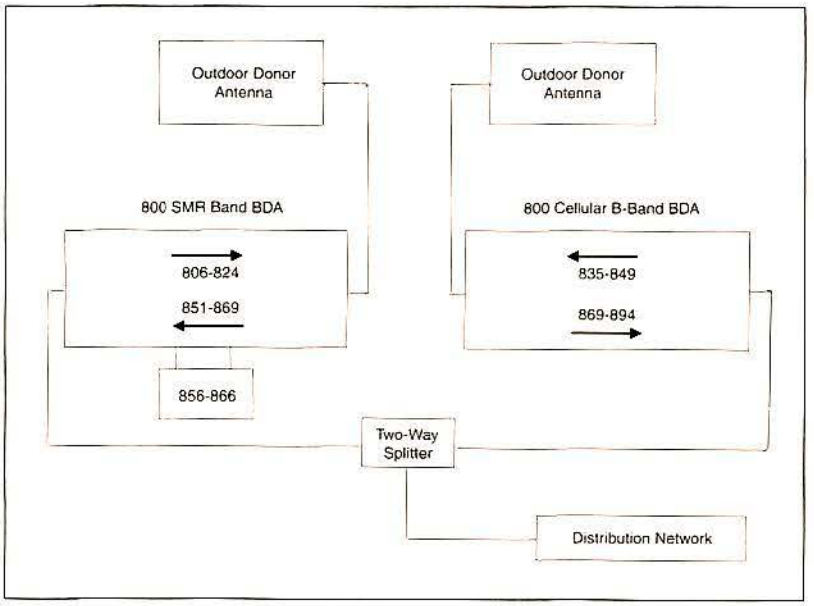
If it is possible to separate the antennas vertically and horizontally, and place them back-to-back, enough isolation might be achieved to prevent the oscillation.

Unfortunately, separating the donor antennas by a great distance at the San Diego site was not practical, as shown in the above photo.

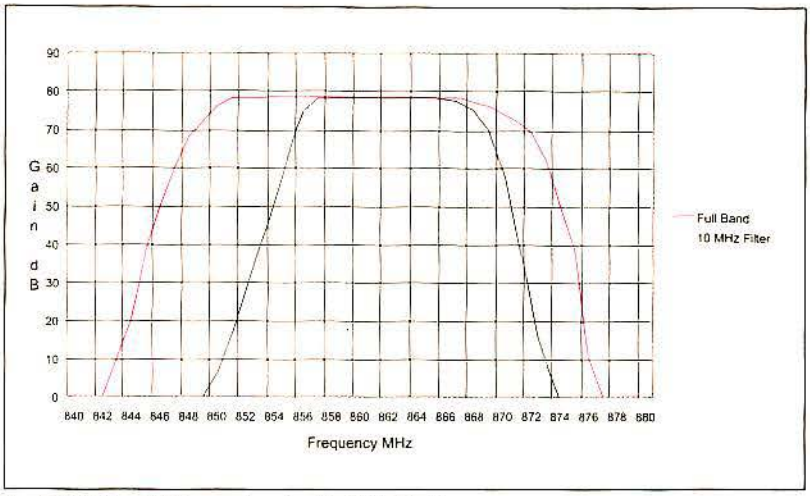
Two corner reflector antennas placed back-to-back with about 10 feet of separation provide about 65dB of isolation. With the separate donor antennas and the isolation of the two-way splitter, 90dB of attenuation had been achieved. Another 70dB was needed. Filtering was then considered.

A band-specific cellular repeater provides exceptional rolloff at the band edge by the use of down-conversion filtering. As shown in the passband curve graph above, the gain in the uplink of a band-specific BDA is greatly reduced at 851MHz. This will not provide complete relief at 849MHz—but it is a start. Unfortunately it is also *expensive*, and additional filtering will *still* be needed in the downlink of the SMR band repeater to reduce the gain at 849MHz. Even with the additional filtering, the loop gain at 851MHz in this case was 120dB, and the attenuation was only 90dB.

A short discussion with the maintenance technicians revealed



The eight-pole, 10MHz combline filter (tuned to rolloff at 856MHz) was added into the SMR band repeater in the downlink path.



An 800MHz SMR passband with 10MHz filter.

that the operating frequencies of the SMR system were all grouped in a 10MHz band above 856MHz. As such, an eight-pole 10MHz combline filter, tuned to rolloff at 856MHz, could be used to attenuate 849MHz *and* 851MHz.

This filter was added into the SMR band repeater in the downlink path as shown in the block diagram at the bottom of the facing page. The cost of the filter was $200 and, as shown on the passband curve graph at the left, it reduced the gain in the downlink of the SMR BDA to such a level that the more expensive, band-specific, cellular repeater was not needed.

After the filtering, the loop gain was barely above 80dB at 851MHz, and the 90dB of isolation in the system prevented oscillation.

The city of San Diego needed coverage for maintenance workers via the 800MHz SMR radio system. It wanted cellular service as a backup. For the price of a low-cost, cellular BDA and a corner reflector antenna, the city was able to get both services working on the same network.

It is not always this easy to combine 800MHz BDAs on a common network, but it *can* be done. ■

Project 25

Does the digital radio standard come up short?

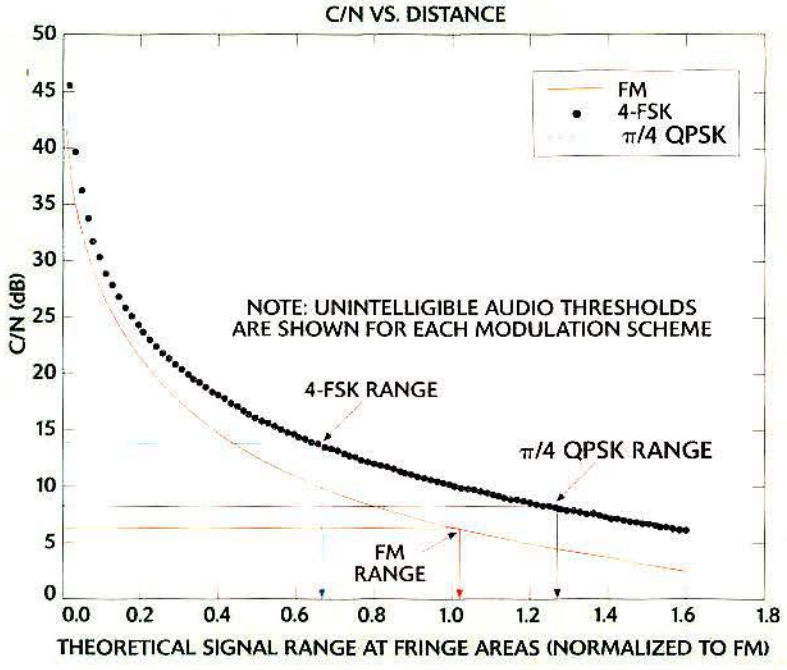
Computer modeling reveals why many coverage predictions do not agree with real-world performance. When designing digital systems, engineers overlook the importance of carrier-to-noise ratios at their peril.

By Stephen Bartlett

A couple of years ago, I created a computer simulation of digital radios with some TIA-102 (a.k.a. Project 25) characteristics. I was motivated to create these computer simulations by information being passed around in some public safety radio circles that narrowband digital radios may have inadequate system coverage compared to analog FM. I wanted to understand if there was a *theoretical* basis that would contribute to this reduction.

I specifically modeled a four-level, frequency-shift-keyed transmitter (similar to the current TIA-102 Phase-I C4FM digital modulator) and a π/4QPSK transmitter (similar to the future TIA-102 Phase II CQPSK digital modulator) with matched receivers. When I ran these digital radio models through performance tests, I uncovered a potential for reduced system coverage in the 4-FSK modulation scheme.

The 4-FSK modulation suffers from a signal-quality problem that reduces system performance. Since learning of it, I have wrestled with how to share the information with the mobile radio community.



C/N curves for the modeled modulation schemes compared to legacy FM system range.

I have no personal interest in the TIA-102 standard, except to recognize its potential as a definitive step in the evolution of digital public safety radio. I have yet to verify with hard evidence that this problem has been observed in an actual operating digital narrowband system.

There are potential limitations to these new systems, however, that should be taken into account during system planning and design.

Receiver characteristics

System coverage depends primarily on how well a radio receiver can discern a signal from any local channel noise and provide recognizable communications. The ratio of signal power to channel noise in the receiver is called the *carrier-to-noise ratio*. The greater the C/N value, the better the communications potential of the radio. Various parameters can affect the C/N of any receiver:

- ❑ transmit signal power.
- ❑ transmit signal quality, especially the *noise immunity* of the modulation scheme, which is important in digital radio design.
- ❑ receiver sensitivity, which is strongly dependent on the receiver's effective bandwidth and the channel noise. Wider bandwidths detect more noise.

▶ *Transmit signal power* — A narrowband signal, by itself, does not reduce radio range.

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Consider the example where two radios have identical modulated waveforms with identical output power, but different bandwidths—one being narrower than the other. A radio's transmit power is defined as the average power of the signal over the radio's operating bandwidth.

For the same average power, the narrowband transmitter will have greater energy per Hertz as a wideband transmitter. At the receiving end, the narrowband receiver will have less noise to overcome because of its narrower effective bandwidth.

Given these conditions, the narrowband receiver will have a greater C/N value than its wideband counterpart and, therefore, should have a *greater* radio range—not less. Of course, the waveforms and modulations of digital and analog radios are different, and any comparison based solely on transmit power is incomplete.

▶ *Transmit signal quality* — The primary design difference between analog and digital transmitters is their modulation method.

Most legacy mobile-radio systems use analog frequency modulation to transmit audio information over the RF carrier.

Digital systems use a variety of modulation schemes, including frequency-shift keying, phase-shift keying, amplitude modulation, (sometimes also referred to as linear modulation) and time-based schemes, such as pulse-position-modulation. Digital systems can carry large quantities of data using high-density signaling with base-2 multiples of signal states, such as binary (2^1), quadrature (2^2), and higher dimensions (2^n).

Digital design techniques

Two basic design techniques used in digital modulation affect the quality of the digital signal before it modulates the RF carrier: *symbol orthogonality* and *pulse shaping*.

An ideal digital modulation will enable the signal to be detected in high-noise environments. This is best accomplished with a modulation scheme using orthogonal symbol states. With this technique, modulated symbols are separated as far as possible in phase space for maximum energy-per-bit spacing.

The significance of orthogonal symbols is especially apparent in the presence of increased channel noise, where the C/N will reduce and the symbol states will spread from having well-defined phase states to having ill-defined ones. In spite of this phase spreading, the receiver will still detect each symbol state with a low probability of error because there is essentially no symbol overlap between orthogonal states.

Orthogonal symbol modulation schemes are highly noise-immune with superior BER performance at low C/N values. Both π/4QPSK and CQPSK are orthogonal modulation schemes. Non-orthogonal modulation schemes perform differently. Non-orthogonal symbols cannot be separated far enough in phase or bit energy to prevent them from overlapping.

Consequently, when these symbols are demodulated in the presence of high noise, the receiver can't distinguish between adjacent, overlapping symbol states. This results in a high probability of detection error.

Non-orthogonal modulation schemes are less noise-immune, with poorer BER performances. Both the 4-FSK and C4FM schemes are non-orthogonal.

To better maintain the narrow-bandwidth spectral isolation and to reduce channel interference, the TIA-102 standard requires that digital signals be *pulse-shaped* prior to modulation to reduce what is termed *spectral blooming*. Pulse-shaping rounds off the edges of a digital signal's square wave to reduce abrupt changes in the modulation with each change of symbol state.

This pulse shaping is done with a tightly specified, *raised-cosine* rolloff filter having a rolloff factor of 0.2—a tight specification. Such tight filter specifications can cause high sensitivities to timing jitter, and they contribute to increased inter-symbol interference.

This ISI noise component can reduce the overall receiver BER performance, and it is especially problematic for less-noise-immune, non-orthogonal modulation schemes, such as the 4-FSK transmitter I modeled.

▶ *Receiver sensitivity* — Digital systems are measured by their bit-error-rate performance over varying C/N. A receiver's effective bandwidth is defined differently in analog and digital systems. The effective bandwidth is generally estimated as the width of the receiver's channel passband between the 3dB points above and below its center frequency of operation.

For FM radios, however, the *Carson's Rule* bandwidth is used

(defined as between the −20dB points) and is about 12.6kHz for a typical wideband (25kHz-spaced) analog FM radio.

For digital radios, the effective receiver bandwidths can be defined by the baseband filters and the symbol rates. The symbol rate of the TIA-102 radio is 4,800 symbols per second (9,600bps at 2 bits/symbol).

The cosine filter's 20% rolloff factor, mentioned earlier, defines an effective channel bandwidth of [1.2 × 4800] = 5,760Hz for the TIA-102 receiver design. This receiver design is specified for both the C4FM and CQPSK systems.

Signal levels, rather than C/N ratios, are the norm for specifying receiver sensitivities. To convert them to C/N ratios requires knowledge of the theoretical noise power of receivers. The different noise thresholds for these receivers can be found from their effective bandwidths using the general equation for thermal noise power:

$$Pn = kTW$$

where

Pn = thermal noise power

k = Boltzman's constant (1.38×10^{-23} J/K)

T = antenna temperature (°K)

W = effective bandwidth of the receiver (Hz)

A more convenient number for the kT factor at 300° Kelvin is −174dBm/Hz. Add to this number the effective receiver bandwidth (converted to dB), and the thermal noise of each receiver can be derived.

For an FM radio, this equates to [10 log(12,600Hz)] = +41dB, which, when added to −174dBm, results in −133dBm of thermal noise power in the FM receiver's channel. The noise power for the 5,760Hz digital receiver used for both the 4-FSK and π/4QPSK models is similarly determined to be −136.4dBm.

When these noise figures are subtracted from the specified input signal levels, the equivalent C/N ratio (in decibels) can be determined.

Computer models

In my study, I modeled the FSK and PSK modulations using quadrature (2^2) signal states and fashioned these designs in accordance with the TIA-102 digital standards for symbol encoding, modulation and raised-cosine, pulse-shaping filter parameters. The 4-FSK transmitter model encoded two symbol states (00, 10) at ±600Hz frequency deviation from the center carrier and the additional symbol states (01, 11) at ±1,800Hz frequency deviation from the center carrier. This resulted in a waveform equivalent to the C4FM modulation.

The second model, a π/4QPSK

transmitter, used the TIA-102 phase-encoding scheme, resulting in a waveform equivalent to the CQPSK modulation.

For the receiver, I modeled a phase-lock-loop FM detector. The FM detector is the receiver specified in the TIA-102 standard suite intended to receive the C4FM and CQPSK signals. Unfortunately, my simulation could not reliably detect the $\pi/4$QPSK signal with the FM detector as modeled, so I used a simple quadrature detector for the $\pi/4$QPSK instead.

Between the transmitter and the receiver, I inserted a simulated Gaussian white-noise channel to simulate a varying C/N. I used no dynamic Doppler or multipath simulations.

This was a simple way to generate ideal, static BER curves for analysis. I used the 5% BER threshold to compare the performance of these two digital models. Beyond this 5% threshold, vocoder audio rapidly degrades and becomes unintelligible.

My performance tests sampled many C/N values to plot BER performance curves for each of the digital system models. From these curves, I found that the 5% BER threshold was reached at a different C/N value with each model.

For the 4-FSK transmitter with the FM detector (the C4FM-like model), the 5% threshold was reached at C/N = 14 dB. For the $\pi/4$QPSK with a quadrature detector (the CQPSK-like model), the 5% threshold was reached at C/N = 7 dB.

This wasn't a surprising difference between the two systems because they do differ by a few decibels in theory, but the poor performance of the 4-FSK system *was* unexpected. When I investigated why the 4-FSK digital system had performed so differently, I found that the transmit-signal quality was reduced by the combination of non-orthogonal FM symbol states, complicated by the ISI from the tight rolloff filter.

Next, I had to determine if the model was giving me valid results, so I compared these threshold values with various specifications and published data of the measured performances of TIA-102-type radios. Using published signal strengths expected for these radios, and subtracting the receiver noise power calculated previously, I converted the signal levels in the specifications to their equivalent C/N ratios for their appropriate effective bandwidth.

The TIA-102 standard specifies the 5% threshold at −116dBm, which translates to a C/N = 20.4dB. A government Web site was used

as a reference for various measured signal strengths for a typical C4FM narrowband radio receiver. There, the 5% BER threshold was reported to be at a signal level of −121.4dBm, which translates to C/N = 15dB—close to my 4-FSK model's performance curve.

Another reference was found in a manufacturer's data sheet that advertised its receiver's performance, at the 5% BER threshold, to be at a circuit merit figure of 2, with C/N = 14dB. It seems, therefore, that my 4-FSK model's 5% BER threshold of 14dB C/N was typical of 4-level FM systems, possibly better than expected for the C4FM TIA-102 specified design.

Performance vs. range

The most obvious place where a difference in range performance would be realized is in the fringe areas of radio system coverage where low C/N ratios result from low signal strengths at the radio's range limits.

The analog FM receiver has some advantages in these low-signal areas with its ability to capture and track a received signal through increased static noise as signals fade.

FM detectors use a technique called *threshold extension* that provides FM detection sensitivities as low as C/N = 6dB. The FM reception becomes unintelligible below this threshold level, which is where FM receivers are generally set to mute (squelch).

Although the narrowband digital radio has the advantage of constant audio quality over the majority of coverage area, its quality falls rapidly in fringe areas. Weak signals in these areas create audio artifacts in the digital receiver that sound like pops, echoes and missing syllables. For a digital 4-FSK type of system, these fringe-area artifacts can become especially problematic when the C/N falls below 14dB because the 5% BER signal threshold is exceeded and the vocoder ceases to reliably detect audio.

So, how do these different performances compare in range capability? The graph on page 56 shows C/N curves for the modeled digital modulation schemes compared to a legacy FM system's expected range in the fringe areas (defined as C/N < 30dB). Each threshold point is labeled on these curves to compare the C/N sensitivities of each radio technology. The typical wideband FM system becomes unintelligible at about C/N = 6dB, while the modeled narrowband 4-FSK digital system becomes unintelligible at the measured 5% BER of C/N = 14dB.

Effects on coverage

To understand how these C/N sensitivities can affect the radio coverage, we'll consider how the C/N thresholds are related to the range between the transmitter and receiver.

To illustrate, I've used a simple free-space propagation profile, where transmit power falls off, as the square of the propagated distance, resulting in a 6dB drop in power (one-fourth relative power reduction) for every 3dB of increased range (twice the relative distance).

At every point along the range axis, the propagated signal strength is identical for each receiver. However, because each receiver has a unique C/N value, the FM receiver would detect more noise—about $10 \log(12.6 \div 5.76) = 3.4$dB more noise—at every point in the coverage area, as illustrated by the shift to the left of the FM curve.

The threshold difference between the FM and 4-FSK curve is 4.6dB. Because of the poorer BER performance, the 4-FSK digital system would reach its 5% threshold much closer to the base station than its FM counterpart, in spite of a better receiver noise figure.

This was the just the kind of theoretical basis for reduced range I was seeking.

The poor transmit-signal quality of a non-orthogonal 4-FSK makes it difficult for the FM detector to reliably receive the digital signal in noisy environments. The 4-FSK receiver requires the greater C/N ratios closer to the transmit site to reliably detect its signals.

This 4.6dB difference in threshold translates to a 2.3dB theoretical reduction (~30%) of usable range between the 4-FSK and FM systems.

As a practical example of what this may mean, if an FM system, providing a usable range of 30 miles, was replaced with a 4-FSK

type of digital narrowband system, the new system's range has the potential of being reduced to only 21 miles.

Therefore, in situations where a range reduction is noted after installing a new digital narrowband system, check for the usual technical problems first, and don't assume the delivered power from a narrowband transmitter is to blame. It may be the digital-signal quality that is at fault, and the only cure will be to invest in more infrastructure.

Of special interest in the graph is the difference in system coverage of the narrowband $\pi/4$QPSK digital modulation model. Comparing the $\pi/4$QPSK C/N curve to the wideband analog FM system, there is a 2.4dB improvement in thresholds points.

The superior BER performance of the $\pi/4$QPSK model, with a measured 5% BER and C/N = 7dB, shows the $\pi/4$QPSK radio may detect signals well into the channel noise, and continue to operate long after the FM radio's mute threshold has been reached.

This translates into a potential system range improvement of about 32%, extending the FM range of our hypothetical system from 30 to nearly 40 miles, primarily due to the high-quality orthogonal symbol modulation scheme in the $\pi/4$QPSK transmitter.

Predictions and performance

These digital-radio-modeling-study results indicate the potential for coverage differences between wideband analog and narrowband digital systems because of differences in design and radio performance. The most important coverage factor for the digital radio is its BER performance. When planning new digital systems, the receiver's C/N and the potential range at the 5% threshold may be the most important factors considered.

However, the C/N is seldom, if ever, considered by many LMR system designers when modeling the digital coverage. With the lack of C/N considerations, radio system designs that seem to perform well in computer modeling programs, or even in controlled low-noise laboratory environments, may perform poorly in the real world where radio channel noise is prevalent, unpredictable, and always changing.

This is the primary reason why many coverage predictions don't agree with real-world performance.

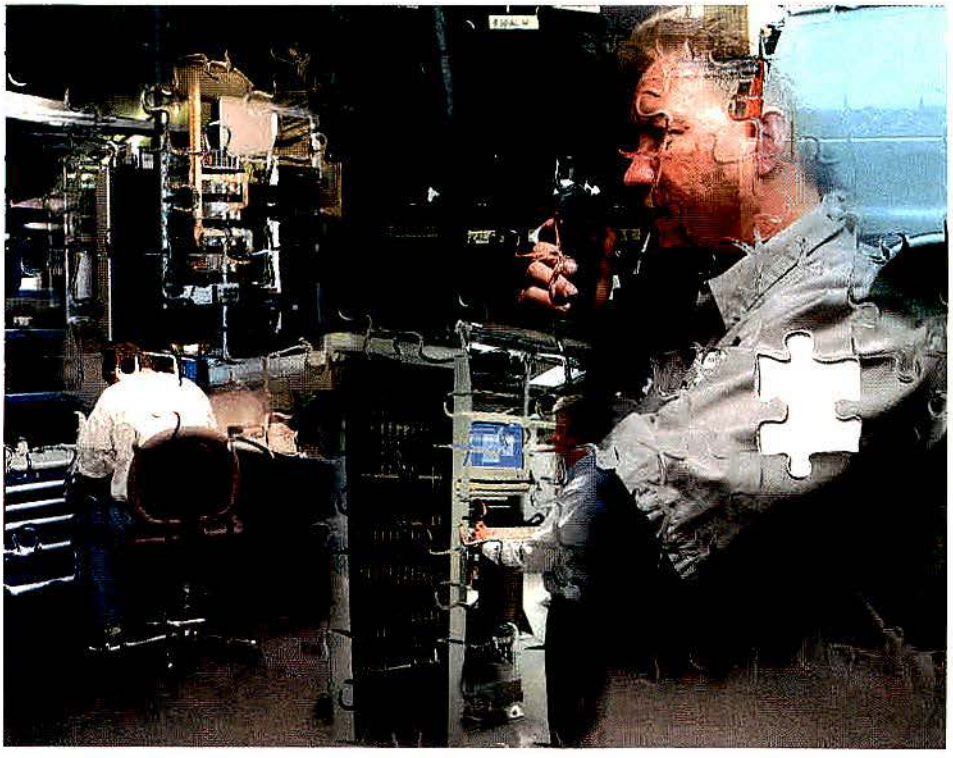
LMR system upgrades can be achieved, with minimal coverage loss, by responsible system planning and engineering, combined with realistic expectations of performance for these technologies. ■

A case for local integrators

Are you one of those local operators who is uncomfortable selling anything that doesn't beep, squawk or light up? Shifting your product line from 'hard' goods to service products may be a difficult culture change—but it may be time.

By Robert H. Schwaninger Jr.

Consolidation of market segments continues to be the norm in telecommunications. This gives rise to the questioning of the role of local operators and shop owners in the future.



Local operators know pricing, delivery history, interoperability and market acceptance regarding equipment and associated technologies. They know whether Kenwood or Motorola or DX Radio or whoever is producing the product that would reliably serve a company's needs.

It would be conventional wisdom to declare this class of businesses as obsolete or unprepared for the changes likely to be wrought in the future. But such high-handed dismissal does not reflect the changing nature of small business operators.

Rather than minimizing the role of local operators, one should look beyond the headlines and stock reports of the Wall Street dandies and focus on the strengths, challenges and changing nature of the local entrepreneur. By carefully observing the relative strength of the local operator, you will discover that local operators are amply positioned for changing times and changing roles.

Despite the market strength of large, publicly traded corporations, these same corporations lack the ability to comprehensively distribute the foremost demanded service: *information*.

Customers and users of wireless services are seeking customized solutions to on-site problems, not theoretical models of operation. As customer sophistication grows, customers can discern operational differences between their communications networks and the perceived advantages enjoyed by other firms.

Undoubtedly, a large industrial concern can garner enough attention to merit a visit from a representative of an equally large equipment manufacturer. However, many midsize firms do not receive the same attention, and smaller companies are given only "plug-in" solutions to unique situations.

The industry suffers from a lack of equipment and service *integrators* that can review the on-site challenges of a business and devise customized solutions—without concern for specific product lines.

Enter the local experts

One of the perennial challenges that I have faced is how to

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convince local operators that *they* possess a greater knowledge of products and services than most, if not all, representatives of any specific equipment or service. Most significantly, local operators normally either *give away* this knowledge to customers—or simply never provide it.

The knowledge possessed by local operators spans product lines. A two-way shop owner knows whether Kenwood or Motorola or DX Radio or whoever, is producing the wireless product that would reliably serve an individual company's needs.

Local operators know pricing, delivery history, interoperability and market acceptance regarding both equipment and associated technologies. It is a sure bet that a local operator would be well-positioned to review invoices, installation performance and operational results to determine whether a customer got what it needed, at a competitive price, to solve a particular problem.

Expertise—*nearby*

Local operators are experts in telecommunications, from the most sophisticated wireless equipment and interconnection capacities to a simple base-and-five. With this expertise and proximity to companies demanding such information, local operators are well-positioned to become the integrators of service, a role that is sorely needed now and one that will become increasingly important over the next decade.

The role of integrator is perfectly suited to local operators. Many manufacturers' representatives have echoed this sentiment and have attempted to encourage local operators to fill this vacuum. However, this culture change is only slowly coming to market, as local operators begin to realize the potential in providing this service.

The role of a telecommunications integrator is multifaceted. The integrator must be able to interview a customer to determine the customer's objectives, while recognizing that the customer may not possess ample knowledge to articulate all of its objectives. Therefore, the ability to discern information or draw out responses from a customer is important.

Based on a determination of the customer's objectives, the integrator would review the present status of the customer's communications requirements. If an overhaul is needed—the customer requires a new network of equipment

and services to reach the objectives—the integrator would make time, material and cost estimates, including recommending certain manufacturers' products that would provide the desired services at reasonable prices.

The integrator is not selling equipment—but selling advice. Often, the client is willing to pay for calculations that local operators can do in their heads.

If an upgrade is necessary, the integrator would provide a plan for moving the in-place network toward the upgrade, again, providing cost and time estimates.

The best analogy for the services to be provided by an integrator is one of architect or, perhaps, general contractor. By providing to a customer a written report, and sometimes an illustration of the revised network, an integrator is giving the customer a perspective view of the communications system to be built or upgraded.

He is, in effect, providing the drawing and specs and cost estimates that a company requires to understand its needs and the investment required to fulfill its needs.

The integrator is not selling *equipment* but selling *advice.*

Feasibility study

As someone who has been in the "advice business" for about 20 years, I can tell you that companies often require concrete assistance and budget numbers before they can commit to a path. And they are often willing to invest in a study to determine feasibility of various alternatives.

Oddly, the estimates that the company is willing to pay for are those calculations that a local operator can often do in his head.

One of the biggest hurdles for local operators who want to offer integration services is the devaluation of their skills and knowledge. People tend to think that if it's not difficult for them to do, they should not *charge* much for it. Many lawyers, for example, do not know where to draw the line between friendly, free advice and giving away the store.

Remember, gathering what you know took *years* of learning, work, experience and mistakes. You had to study tech manuals, attend seminars, keep up with manufacturer developments, experiment with new equipment and touted solutions, and invest time and money into what works and what does not.

That knowledge is valuable when it is applied to benefit a customer who lacks information from any source other than a sales rep trying to turn a deal.

If integration requires knowledge you do *not* have, subcontract that portion. Find a vendor in your area (say for telephone systems), that will subcontract that portion of the integration report that discusses possible landline upgrades. Talk to a computer outfit that will assist in adding its expertise regarding upgrades of data transfers.

You will quickly discover that a number of experts in your area are willing and able to provide additional value to your consulting agreement. Then put them under contract to *you* so that you control their use, cost and methods to ensure that estimates made to businesses for combined consulting services are realistic—and met.

Again, do not be afraid to market and charge for this service. You will find that providing this service will increase your local networking capacity, give you greater clout with equipment vendors, make you evaluate your product lines in a more objective way, and provide sources of revenues that you did not have in the past.

There will still be local operators who are not comfortable selling anything that doesn't beep, squawk or light up. The shifting of one's product line from only "hard" goods to service products can be a difficult culture change. But remember, you have actually been doing this for years. You call it *airtime.* ■

Radio installing for light weights

Whether it's the Chrysler CCV or the Motor Develoment International TOPS, you'll be ready for air when you apply these techniques to installations in all-plastic cars.

By Donald Koehler

It was bound to happen some time. Communications installers have seen it coming for years. Metal dashes disappeared, then it was plastic roof liners—now it is the all-plastic automobile. Yes, all *plastic*—as in recycled pop bottles. Chrysler started it with the CCV, a composite concept vehicle made entirely from plastic. Why?

"It could be made from the same material used to make plastic drinking bottles, polyethylene terephthalate (PET)," said Tom Tremont, chief designer for Pacifica, Chrysler's West Coast design studio in Carlsbad, CA. "PET technology has the potential to reduce manufacturing costs by 80% over conventional methods using steel."

As if this were not interesting enough, now a French company will manufacture an all-plastic taxi powered by ... air. Yes, *air*. About this time, you have to ask, "What is an installer to do?"

Well, for the near future, the North-American radio technician won't have much to worry about. However, readers in Mexico City may face this problem today.

With no practical ground plane, the installer may find some difficulty with antenna mounts. Fortunately, this is not an uncommon problem. Although few of us have cut up a classic 'Vette for a NMO blind mount, most of us have installed antennas on Good Humor vans, polyfoam-insulated refrigerator trucks or the odd golf cart.

Short of gluing aluminized Mylar to the roof with contact cement, a glass-mount antenna should do the trick and keep the owners happy. The vehicle frame, or more properly, subframe, does contain a significant amount of steel. Antenna selection is not as limited as it may seem at first.

In addition to "on-glass" mounts, a magnetic-mount directional discontinuity ring radiator antenna may work as well.

Designed for urban use only, the vehicle should rarely encounter obstacles that pose a threat to chassis-mounted antennas. Hitting the occasional sleeping burro or armadillo should pose no repair problem to the experienced southwestern technician.

Tapping into suitable dc power for the radio may become problematic. The French vehicle made with PET, the MDI "TOP" (Taxi zerO Pollution—hey, it's *French*, OK?), is powered by compressed air. But it does have a battery for lights, signals and the like. Any communications system that you install in a TOP should be sized for minimum power draw. Some models may be hybrid, running on both air and some type of hydrocarbon fuel—

As plastic concept vehicles prepare to flood the market next April, only a fool would pass up the opportunity to learn new radio installation techniques for this market. Pictured: Chrysler CCV.

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permitting a more "normal" powered installation.

Back to the air-powered part. The compressed air is stored under the floorboards in several steel or fiberglass tanks. Recharge is via an on-board compressor or at a central re-airing station.

One cautionary note for new installers: Care is needed *before* drilling into the body. Because the air is stored at 4,351psi, or 300 bars, any installer will do well to *closely* examine the proposed installation site. Measuring twice is a good idea. A high-speed drill bit hitting a tank or manifold would be—exhausting, to say the least.

A remote-head radio probably is the best choice. This will allow the radio to be installed next to the battery supply, and a thin—possibly fiber optic—control cable can be routed to the front. The cable can be easily glued into place to prevent movement.

Careful use of an X-acto knife and more glue would permit an overhead routing. The reduced weight of just this type of system is a positive factor, given the nature of the dash area.

Because PET seems to be the preferred choice of material for a composite auto body, the smart installer will closely *test* any glues or other attachment methods prior to use. Testing should pose no problems, judging from the amount of empty plastic soda bottles that seem to inhabit a busy work bench.

As with any installation, always check with the user for control placement and double-check before any drilling is attempted. By mounting the radio near the power source, you have less cable to run.

If you're thoroughly confused by our anticipation of demand for working with this new technology, recheck the cover date of this issue. *HAFD!* ■

Learn more (no joke)

To learn more on this upcoming technology revolution (think $5/gal for gasoline) check out:

- ❑ www.howstuffworks.com/news-item106.htm
- ❑ www.car-truck.com/chryed/concept/ccv.htm
- ❑ www.zeropollution.com/zeropollution/index.html for photos of the plastic, fantastic, taxi of the future. Prototypes are running around France now; U.S. safety rules currently prohibit this kind vehicle on the road. Perhaps a large resort would find first use for this futuristic "air-power" system.

States can license spectrum in 700MHz band

Public Safety

The FCC has released a public notice alerting states of the ability to apply for a state license for public safety services in the newly allocated 700MHz band. The notice, DA-01-406, was released on Feb. 15 and provides the detailed information necessary for states to apply for all or part of the 192 channel pairs (2.4MHz) of spectrum reserved for state geographic licensing.

The deadline for notifying the FCC of a state's decision is Dec. 31, 2001.

The governor of each state is the person authorized to apply for the state license using the FCC Form 601, according to the notice. Attachment B to the public notice contains details about how to apply for a state license.

States should manually file applications through mid-2001. At that point, the Universal Licensing System, an interactive licensing database developed by the Wireless Telecommunications Bureau, is expected to be available to process applications for state licenses filed on-line.

The Public Safety Wireless Network issued a fax alert on Feb. 22, and the Association of Public Safety Communications Officials–International issued a release urging states to apply for the licenses.

"I highly recommend that all states apply for this spectrum regardless of their current state of preparation to utilize the grant," said Ron Haraseth, director of APCO automated frequency coordination.

"The deadline is Dec. 31, but according to the previously issued third Memorandum Opinion and Order and Third Report and Order in docket 96-86 (FCC document 00-348), the FCC has left the fine details of justification to a later date," he said.

According to Haraseth, the later date is tied to estimates of when the incumbent TV channels will be vacated starting Jan. 1, 2007. At that time, the states will be required to certify they are preparing or are providing substantial service to one-third of their populations or territory by Jan. 1, 2012 and two-thirds by Jan. 1, 2017.

The FCC warned in the notice that any part of the 2.4MHz a state does not apply for by Dec. 31, 2001, will revert to General Use.

FL system expands by 19 channels

The FCC has granted the state of Florida a waiver to obtain licenses for 19 off-set channels. These frequencies are centered between regularly assigned channels within a block of 20 contiguous 800MHz general category channels currently licensed statewide by the state.

The state of Florida filed a request for this waiver in August after meeting with the design team of Com-Net Ericsson Critical Radio Systems, Lynchburg, VA. Florida's request stated that because the state is covered by the composite footprint of its licensed stations, other users could not gain access to these 19 off-set frequencies. With the waiver, the state would be able to increase its capacity and coverage with these frequencies.

The FCC determined that the waiver is warranted and furthers the public interest. In its ruling, the FCC stated the communications needs of public safety officers and their requirements for interoperability are the primary goals of the commission.

Datamarine to supply 220MHz mobiles to Securicor Wireless

For several years, Securicor Wireless, New York, has needed a suitable manufacturer for its 200MHz, linear modulation mobile transceiver. Its sister company, Securicor Radiocomms, initially provided units, but it was not a suitable long-term supplier because it was not equipped to make large quantities. Securicor next turned to the E. F. Johnson subsidiary of Transcrypt International, but after making some mobiles for Securicor, Johnson exited the "original equipment manufacturer" business last year.

Datamarine International, Mountlake Terrace, WA, is Securicor's next hope for a source of mobiles at a competitive cost. The two companies inked a joint product development, manufacturing and distribution agreement in January.

Datamarine already offers 220MHz mobiles and repeaters under its SEA brand. Why the cooperative agreement with a competitor?

"It's an important step forward for the 220MHz radio service to have two major suppliers working together to make the service develop," said Datamarine's president, David Thompson. "Also, Securicor is not interested in product development and manufacturing. Because we do like product development and manufacturing, we fill a role for them at this time.

"I think the important thing is that Securicor will now be selling MPT 1327 and LTR systems. ...[T]hose two operating systems fulfill different market needs, and they represent different cost levels for dispatch systems. Securicor has [licenses for] a lot of spectrum, so they'll have customers who want a lower-cost, less-complicated system to do certain things and that will enhance their ability to meet customer demands," he said.

Securicor's products use trunking based on the UK-developed MPT 1327 protocol and dubbed "advanced digital network trunking." Datamarine's products use the Johnson-developed "logic trunked radio" or LTR protocol.

Thompson said Datamarine brings engineering expertise and its own OEM, Maxon, to the partnership.

"Our offshore manufacturer had a difficult time last year, but we know all those problems have been resolved. We are confident that there's going to be a continuing flow of radios in whatever quantity Securicor and SEA required," he said.

Thompson said it was too early to predict how many units Securicor is likely to order.

Times Microwave hosts training seminar

In January, Times Microwave Systems, Wallingford, CT, hosted a regional training seminar in conjunction with Johnson Associates Rep Group of New England, PolyPhaser, Telewave and Microwave Tower Services.

About 80 two-way dealers, installers and end users attended. Product and training presentations were made by the companies. The seminar also included a tour of the Times Microwave Systems product operation.

PSPP meets to fine-tune agreement

The European Telecommunications Standards Institute and the Telecommunications Industry Association met in Mesa, AZ, on Jan. 30 to sign their final partnership agreement and to welcome the South Korean standards organization, the Telecommunications Technology Association, into the partnership as an observer.

This Public Safety Partnership Project has been established to meet the advanced mobile broadband needs of public safety users and to develop new standards within a global context.

"The PSPP represents a unique opportunity for industry to absorb and understand the specific harmonized requirements of public safety organizations across the world's regions," said Dan Bart, senior vice president, standards and special projects at TIA. "PSPP will produce the technical specifications, and the participating standards organizations will produce the official standards. We strongly encourage industry and public safety organizations to join this partnership."

Organizations can register online at **www.ps2p.org**.

The mobile broadband specifications will be intended to meet a variety of public safety applications, including the expanded use of wireless and remote robotics.

Possible uses include the containment of chemical spills, the disarmament of bombs, fire management and control, the identification of hazardous conditions within a fire, locating fire hot spots, pinpointing the locations of victims and firefighters and many other audio, data, visual and robotic operational functions that are needed in law enforcement and the fire and emergency medical services sector.

This new PSPP technology has been named MESA (mobility for emergency and safety applications), after the city where the final agreement was signed.

MRT adds to editorial staff; Roger Lesser named editor

Lesser

Intertec Publishing, owner of *Mobile Radio Technology* and *RF Design* magazines, has named Roger Lesser, *RFD's* editor, to fill the additional post as editor of *MRT*. *RFD's* senior art director, Maurice Lydick, adds to his responsibility for *RFD* and takes the same position with *MRT*.

The group publisher for both magazines, Mercy Contreras, said that she made the appointments to further integrate the editorial staffs of the two magazines. *MRT* and *RFD* already share the efforts of their editorial director, Don Bishop, and senior associate editor, Nikki Chandler.

"We've seen the value of a team effort between the two magazines, and we want to draw even more upon the valuable ideas and expertise from one magazine to the other," Contreras said.

Lesser said, "I'm excited about the opportunity to work more closely with the *MRT* staff and to become more involved in covering the two-way radio industry."

Since retiring from the Air Force as a lieutenant colonel, Lesser has spent eight years in publishing. He was editor of *Defense & Security Electronics* for four years. He joined the editorial staff of *RFD* in 1997.

Lydick has worked in publishing for 20 years, including art direction for *RFD* from 1983 to 1993 under a previous owner. He also provided art direction for *Communications*, a magazine that covered two-way radio communications. He joined Intertec Publishing in 1997 and became *RFD's* senior art director last year.

Meanwhile, Matthew Halverson, who had been *Mobile Radio Technology's* associate editor since last year, has moved over to Intertec's *Electrical Construction & Maintenance* magazine. Kari Taylor has been named *MRT's* new associate editor, moving over from a position with Intertec's advertising production department. A graduate of the University of Missouri School of Journalism–Columbia, Taylor worked in advertising and public relations before joining Intertec.

Motorola expects to fall short of projected earnings

Motorola, Schaumburg, IL, announced on Feb. 23 that as a result of significant weakness in first-quarter order input across its business segments, the company does not expect to achieve the first-quarter 2001 sales guidance of $8.8 billion or the earnings guidance of $0.12 per share given on Jan. 11, 2001.

Motorola issued a release stating that the sharp economic slowdown occurring in the United States and inventory corrections taking place broadly in technology markets worldwide have caused the adverse change in its order pattern. Should the pattern continue, the company expects to incur an operating loss in the quarter.

The company has been hit hardest by slumps in its cellphone and computer chip business, and has announced about 6,500 layoffs since January.

Scanning ...

Andrew, Orland Park, IL, has acquired the remaining 30% equity in its **Andrew Industria e Comercio Ltda** and **Andrew Comercio e Servicos Ltda** subsidiaries, Sorocaba, Brazil. The transaction was for a cash amount that has not been disclosed. Andrew originally acquired 51% of both companies on Dec. 5, 1995, and raised its interest to 70% on Oct. 30, 1997.

Vytek Wireless, White Plains, NY, has acquired **Sonik Technologies,** Vista, CA.

Allen Telecom, Beachwood, OH, reported sales of $106.9 million for the quarter ended Dec. 31, 2000, an increase of more than 17% over $91.5 million for the comparable quarter last year.

Seneca Financial Group, Greenwich, CT, has been retained by the Chapter 7 trustee of TSR Wireless to be its financial advisor. Seneca will work with the court-appointed Chapter 7 trustee, **Charles Forman,** to develop and implement a divestiture plan to maximize the recovery for TSR Wireless' creditors.

New FCC Chairman **Michael Powell** will deliver the keynote address at the CellularTelecommunications & Internet Association's Wireless 2001 in Las Vegas, which runs from March 20–22.

Dataradio, Atlanta, will supply a mobile data communications system for the Jefferson County, AL, Sheriff's Department. This system will provide 165 vehicles in the county with secure wireless data transfer in the 800MHz frequency band at 25.6kbps.

VisionAir, Castle Hayne, NC, will provide VisionCAD, VisionRMS and VisionMobile to the city of Vacaville, CA. The city also purchased Inform, the company's Web-based Intranet product.

Mobile radio offers UHF networking

Kenwood's TK-880 mobile radio offers UHF wide-area networking. In addition to individual conventional and LTR trunking systems capability, the company now offers the Passport trunked networking option. The option is compatible with the Trident Micro Systems NTS network-switch Passport air interface protocol. The Passport option's user-friendly display and controls make network communications virtually transparent to the user and as easy as any other radio system operation. Each radio unit contains a unique electronic serial number with which operators can choose to provide system access security against unauthorized or lost and stolen units and even disable units over the air.

This mobile handles 32 systems and 250 groups in trunked mode. It meets Mil-Spec standards 810 C, D and E and features a die-cast chassis and a bright 12-character dot-matrix LCD.

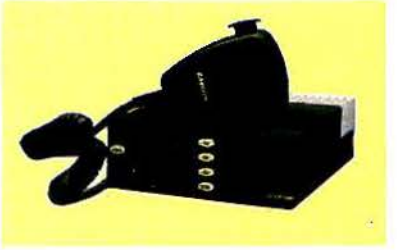
WWW.KENWOOD.NET

Radios available in low-band, UHF models

Patriot RPM series mobile radios from **Ritron** are available in low-band (30MHz–50MHz), VHF (146MHz–174MHz) and UHF (450MHz–470MHz) and with power levels of 60W, 30W and 25W, respectively. The radios feature 16 channels and are PC field-programmable for simplex, half-duplex or receive-only operation. Other features include: wide-band operations, cloning capability, normal and/or priority scan, CTCSS, digital coded squelch, two-tone sequential decode, busy channel lockout, channel monitor lock-out and transmitter time-out timer. The mobile measures 2.1" × 5.8" × 7.4", permitting installation in practically any vehicle.

WWW.RITRON.COM OR 800-872-1872

Analog trunked radio supports Smartnet



The 9883 Smartnet and Smartzone mobile radio delivers as much as 30W of RF power. It is a multimode radio that can be simultaneously programmed with as many as 256 channels (with the correct options) in conventional analog wide, conventional analog narrow, trunked Smartnet II or trunked Smartzone.

The mobile meets Mil-Std 810 C and D specifications for shock and vibration. General features include an eight-character alphanumeric display plus 14 status annunciators, zone selection, channel selection, home zone, mute alert tones, radio wide scanning, priority monitor scanning and conventional scanning.

WWW.EFJOHNSON.COM OR 507-835-6222

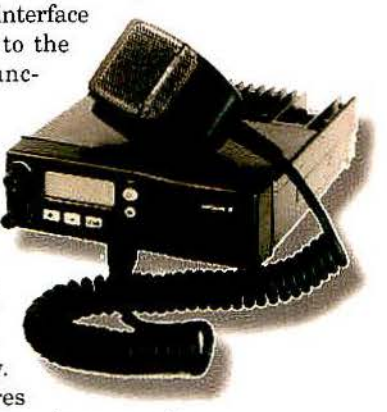
Radio offers flexibility

The MCS 2000 Model I from **Motorola** is software-configurable, which allows the mobile to be upgraded as communications needs change. It offers 48 standard modes with as many as 150 optional modes. It provides an eight-character, positive-image LCD, and the display indicators include LEDs, display symbols and audible tones.

The mobile features five programmable buttons, a rotary volume switch, an up and down channel and mode selector and an internal 4W speaker. Its calling capabilities include programmable lists that permit users to send telephone calls, call alert and private call messages.

WWW.MOT.COM OR 800-274-2346

EDACS mobile radio supports public safety



The EDACS 500 mobile radio from **Com-Net Ericsson** has a simplified five-button user interface allowing access to the menu-driven functions such as individual call, phone interconnect, scan and talk-around. The design includes an eight-character alphanumeric display. Standard features include 16 systems and groups, wide-area system scan and EDACS group scan. Optional features such as 800 systems/groups, EDACS emergency, priority system scan and status message provide support for large public safety or utility applications.

WWW.COM-NETERICSSON.COM

Product Encore

Of the new products in the August 2000 issue, this one generated the biggest reader response. For more information on this product, log on to **www.kingusa.com.**

Radio complies with Project 25 standard

King Communications' KMR-25 series includes a Project 25-compatible digital radio. Radios operate at VHF and UHF frequency ranges including 136MHz–174MHz, 403MHz–470MHz, 450MHz–512MHz and 806MHz–870MHz. The radios can also operate on conventional Smartnet and Smartzone systems. They feature 256 channels, and the dimensions are 2.1" × 7.15" × 8.3". The voice digital mode includes voice coding of IMBE 4.4kbps and a frame re-synch interval of 180msec. Accessories include a 12W external speaker, remote-mount conversion kit, spare control head kit and DTMF microphone.

WWW.KINGUSA.COM

Charger conditions and analyzes

The IQpac from **iTECH** is a personal analyzer charger for the land mobile radio market. The charger features tri-mode operation: charge, quick analyzer (to analyze and condition while charging) and spec analyzer (to test batteries to specification standards). The charger is compatible with all popular radio batteries, NiCd, NiMH and Li-ion chemistries and is available in 115Vac and 230Vac/240Vac models. It offers selectable pulse or constant charge with three selectable rates.

WWW.ITECHENG.COM OR 858-458-1500

Fleet manager allows integrated system

The DT-2000 Fleet Manager from **DriverTech** is an AVL and dispatch product for commercial and municipal fleets. The product includes the Truck-PC, a Windows-based mobile data terminal with software applications for two-way digital messaging, in-vehicle map navigation and digital dispatching. These applications are accessed through the company's fleet dispatch Web site or through a PC-based back-office dispatch program. The Trunk-PC can be the core of an in-vehicle system that includes the recording and display of valuable engine data that is available on Class 5 through 8 trucks.

801-466-8770

Mic fits inside ear

Television Equipment Associates' tactical headset fits inside the ear and has mic intelligibility comparable to boom microphones. This bone-mic headset, named Invisio, positions the mic on the user's jaw bone. The headset microphone and receiver are incorporated into an earmold, which will not interfere with gas masks, helmets, goggles or SCBA breathers. The mic picks up voice vibrations from the jawbone, eliminating interference caused by ambient noise.

WWW.SWATHEADSETS.COM OR 310-457-7401

UHF repeater offers 15ms TX attack time

The RRX-460 UHF repeater from **Ritron** offers a fast transmission attack time and a high-spec receiver. The high-spec receiver has 80dB intermodulation rejection, 0.25μV sensitivity and a double balanced mixer for performance in high RF signal level environments. The oscillator uses a ceramic coaxial resonator for an ultra low-noise output spectrum, resulting in better adjacent channel rejection in wideband or narrowband channel allocations. Other features include 450MHz–470MHz frequency range, 61.5ppm (230°C to 260°C) frequency stability, compact size (3.5" × 19" × 12") for standard rack or desktop, "EZ connect" controller option allowing fast interface, 110Vac/220Vac selectable for 12Vdc operation and 100% continuous duty cycle from 8W exciter.

WWW.RITRON.COM OR 800-872-1872

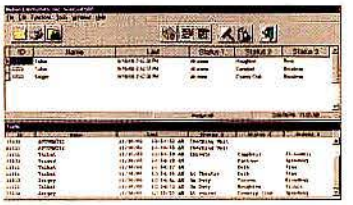
VoIP product expands radio links

JPS Communications' voice-over-Internet protocol product is for the expansion of radio links across IP networks. The NXU-2 is the first in a series of products using JPS' Vipernet technology to provide a full-duplex audio, control and data link across a single IP connection. The product uses high-speed DSP and network processors to multiplex audio, control and RS-232 connections over a single Ethernet connection. Connections may be extended across LAN, WAN or the Internet. The product is standalone, with no external computers needed.

WWW.JPS.COM OR 919-790-1011

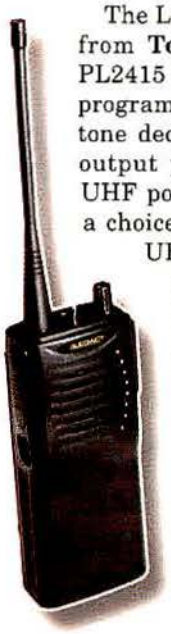
Decoder supports MDC-1200 format

The CAD-500 from **Midian Electronics** is a PC-based decoder that is compatible with Motorola's MDC-1200 signaling format. The product decodes leading, trailing and emergency ANI. The decoder displays the unit ID, the alias, time and date information, as well as the emergency status on the computer's monitor. Midian's ANI-M with MDC-1200 ANI is compatible with the decoder and allows most any radio to be fitted with MDC-1200 signaling.



WWW.MIDIANS.COM

Radios support business apps



The Legacy line of business and industrial radios from **Topaz3** includes the Proline series. The PL2415 VHF and PL2445 UHF radios feature PC-programmable frequencies, 104 DCS codes and two-tone decode. These compact portables offer 2W of output power and four channels. Model PL2245 UHF portable offers dual-channel operations from a choice of eight user-selectable, pre-programmed UHF channels. Model PL1145 offers 1W output power and single-channel operation from the same UHF channel choices. All have rugged, die-cast aluminum frames and durable polycarbonate cases. They are designed to meet Mil-Std 810 F specifications for light rain, humidity, dust, vibration and shock. Common features include 38 standard and 11 non-standard CTCSS tones, a locking accessory jack, monitor button and automatic power save. The radios also have a tri-color status LED positioned on the top panel and a low battery LED indicator/audible alert.

WWW.TOPAZ3.COM OR 800-821-7848

Software tool integrates auto workspace

The Virtual Control Head from **Motorola's Integrated Solutions Division** is a software application designed to centralize access and control of peripherals in a vehicle.

The product controls all vehicle peripherals from one place and provides the option of removing certain peripheral control heads from the vehicle cabin. These peripherals can include voice radios, radar, sirens and lights. In addition to consolidating multiple voice radios, radar, siren and lights, the product also controls any relays provided by the siren box, such as gun-locks, brake lights and dog releases. The application runs on a touch-screen computer alongside the messaging applications, providing a central source for information and control. The VCH buttons can be configured to meet specific needs.

WWW.MOTOROLA.COM/SCA

TETRA set adds enhancements

IFR Systems has enhanced the 2968 TETRA radio test set with the launch of TETRALog Protocol Analyzer, a PC-based protocol capture and analysis applications program that enables capture and detailed analysis of mobile protocol transactions.

Primarily designed for the protocol development of TETRA radios, TETRALog is also a suitable verification and evaluation tool for TETRA mobile developers who do not develop software in-house, but purchase protocol stacks from third parties. The PC-based application program acquires data, analyzing and displaying it graphically in the form of message sequence charts.

The acquired messages (protocol data units) are also fully decoded to product text files of the information elements contained in the messages for display, storage or printing. System providers will also find the facilities useful in evaluating and verifying correction operation of a given radio type to be used on a system.

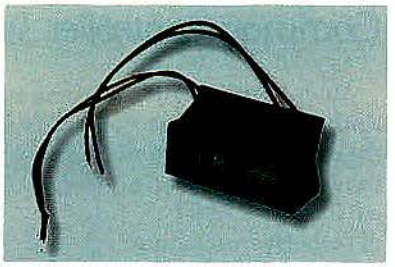
WWW.IFRSYS.COM OR 800-835-2352

Combiner offers precision spacing

The DB4368 combiner from **Decibel Products** is a compact transmitter combiner that offers spacing down to 100kHz per channel. Its standard 19-inch EIA rack is compatible with other types of equipment, units and systems. It operates in frequency ranges from 370MHz to 512MHz. The input power rating is 150W, and the combiner measures 15" × 19" × 31½". It weighs 98 pounds.

WWW.DECIBELPRODUCTS.COM OR 800-676-5342

Filter allows 48Vdc operating voltage



The SM480-8 general-purpose noise filter and spike protector from **Translectric** allows operating voltages as low as 6Vdc and as high as 48Vdc input with a clean and noise-free dc output voltage that equals the input voltage. The unit features a metal-oxide varistor clamp for maximum voltage surge, a low dc impedance, an 8A continuous output current, an LCR low-pass tuned circuit and noise and RF interference protection.

WWW.SERVICEMATE.COM
OR 800-333-2589

Base station kits work with EFJohnson mobile

Models BAK-EFJ and BAK-KMR from **IDA** are base station accessory kits for the RS-5300 series mobile from E.F. Johnson and the KMR-25 from King Communications. The kits offer frequency ranges of 136MHz–174MHz or 806MHz–870MHz with operating modes of conventional, Project 25, Smartnet and Smartzone. They include a wrap-around hood enclosure with a power supply, digital termination panel with local control of the radio, and intercom capabilities that include a front-firing speaker.

WWW.IDACO.COM OR 800-627-4432

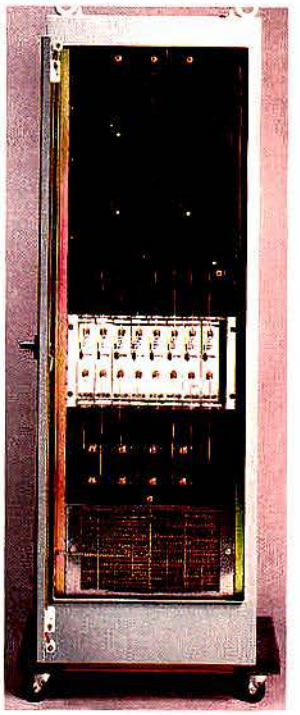
Cataloging program models RF systems

Partsplanner from **Wireless Valley Communications** is a program that helps create a catalog of components that is easily exchanged and viewed electronically. Wireless communications system designers can import a catalog made with the program into Siteplanner 2000 and use your components directly in their RF designs. It also allows the modeling of any type of RF distribution system component, including coaxial cables, bi-directional and uni-directional amplifiers, repeaters, connectors and couplers.

WWW.WIRELESSVALLEY.COM

Booster amplifier provides low noise

AeroComm's multichannel bi-directional booster amplifier, model 50289-MCBA, offers low noise, a high degree of filtering, automatic gain control and a wide range of frequency selection. The unit will enable two-way communications systems to offer coverage in areas that are normally beyond a system's reach. It consists of 16 highly selective channelized amplifiers (RX/TX) configured for an eight-channel, full-duplex repeater. Sixteen synthesized LOs, which are programmable, allow for a highly flexible system. The system is housed in a NEMA-12 enclosure measuring 72" × 24" × 24" and weighs 650lbs per cabinet.



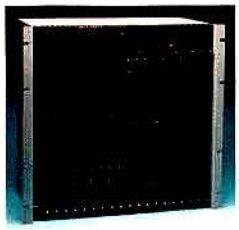
WWW.AEROCOMM.COM OR 201-227-0066

Mobile computer manages fleets

The MC1700 from **Digital Dispatch Systems** is a mobile computer for fleet management. Built on the Intel Strongarm 200MHz processor and Windows CE operating system, the computer enables wireless network support and applications that deliver critical information. The computer features a TFT active matrix; 256-color, touchscreen display; an integrated mapping software package; an on-board flash memory; an internal magnetic card reader; and a GPS receiver. To meet transport company needs, the computer offers a configurable product with the use of the software development kit and supports private and public data networks.

WWW.DIGITAL-DISPATCH.COM
OR 604-214-7231

Common controller supports six consoles



Model 4020 from **Zetron** is a 20-channel common controller that supports as many as six series 4000 radio consoles, including model 4217NT dispatch workstation, model 4118 rack mount button console, and model 4018 desktop button console. The controller is available in "no single point of failure" configurations with a dual-redundant system. Additional features include as many as 10 independent cross channel patches with the patch card, provisions for external time reference, and optional radio system management software.

WWW.ZETRON.COM OR 425-820-6363

Hand-held computer supports industrial apps

The fex21 hand-held personal computer from **Itronix** has been upgraded with a new Toshiba 129MHz processor, external graphics controller, SDRAM memory, Intel Strataflash, longer-lasting Li-ion battery and full wireless support. The computer supports CDPD and Nokia2 GSM wireless protocols in addition to Bell South Wireless Data and Motient systems.

WWW.ITRONIX.COM

Headset supports multiple applications

The Virtuoso multimedia headset system from **Hello Direct** features an amplifier multiplier module that handles Internet telephony and voice-over-IP applications in addition to standard typical telephone uses. When not on the phone, the user can use the same headset for speech recognition tasks, recording audio notes, or listening to Web audio content without disturbing coworkers. The headset includes such controls as mute and volume, and it configures to work with the non-standard handset ports found on digital business telephones.

WWW.HELLODIRECT.COM OR 505-955-9000

Call check system offers instant recall

Echo from **Dynamic Instruments** is a state-of-the-art call check system that provides users with instant recall through software. Users can quickly locate, retrieve and replay calls. A dispatcher or operator can display any one of the latest 50 calls on one of two available channels on the same screen used for other applications. The system can provide from two to 32 positions of call check playback supporting any combination of 32 telephone or radio inputs.

WWW.DYNAMICINST.COM OR 800-793-3358

Fleet system operates with no roaming

Trimble's Crosscheck cellular-based fleet management system offers turnkey nationwide asset management service with no roaming charges. It integrates GPS, cellular and computing technologies into a system that uses the standard wireless analog AMPS cellular network to send GPS data and messages from mobile units to base stations running Fleetvision software. The system supports automated monitoring and reporting of vehicle activity and status that allows it to send an alert report identifying the vehicle's location and status.

WWW.TRIMBLE.COM OR 800-827-8000

Radio link modem features full-duplex TX

The MOD-GWF2 radio link modem from **Albrecht Telecommunications** serves to secure full-duplex transmission of voice, data and commands over narrowband channels for VHF, UHF and HFSSB. It also provides network-wide synchronization for simulcast radio networks. Data transmission takes place over RS-232 and synchronous interfaces. Independent of these, remote control commands can be transmitted in both directions. Data and voice are ciphered using a secure technique. Coding delay is minimal. The modem adjusts automatically to current channel conditions. What ensues is adaptive line equalization and automatic link offset compensation. Beyond this, the transmission is secured with FEC and interleaving.

+41-41-780 47 01

Transmitter analyzes propagation

Berkeley Varitronics Systems' updated Gator Class A stimulus transmitter is for propagation analysis studies. The instrument features Class A amplifiers with adjustable power output in 0.1dB steps, VSWR protection, a light weight and weatherproof housing. The product is available in bands including cellular, PCS, LMR, paging, GSM, IDEN and SMR.

WWW.BVSYSTEMS.COM OR 732-548-3737

Power supplies program remotely

The RGPM series of power supplies from **Protek Test & Measurement** features remotely programmable control by external voltage and resistance. Designed to run efficiently, and cooler, the units are suited for bench operation and similar applications demanding remote control. Operating independently or in master/slave modes, with a series or parallel configurations, the product also provides external sensing for regulation. Users may also remotely set constant voltage/current modes in addition to on/off settings. Other features include isolated inputs and outputs for user safety, ±0.2% accuracy, three-digit LED displays and rear-panel manual operation for special voltage needs.

WWW.PROTEKTEST.COM OR 201-760-9898

Mobile data terminal tracks vehicles

The ePing Emerald mobile data terminal from **SiGEM** advances the integration of GPS and wireless technologies. Fleet managers can use the terminal with ePing Enterprise to track vehicles via the GPS systems and communicate with drivers on a screen that displays jobs and messages.

The terminal features a compact design and can be installed near the driver without interfering with airbag systems. The large display and numeric keypad enable drivers to receive and send textual messages from their vehicles.

The product also includes three serial ports that allow for the addition of peripheral devices such as printers, credit card or smart card readers and debit card pin pads.

WWW.SIGEM.COM/FRAMESETPAGES/EMERALD.HTML

"Products" continued on page 82

Ad Index

Company	Page Number	Fast Fact Number	Advertiser Hotline
AC/DC Industries	91	109	281-933-0909
Advanced Battery	75	53	781-767-5516
Advanced Receiver	70	58	860-485-0310
AEA	78	66	760-598-9677
Aerocomm	7	8	201-227-0066
Air Comm	90	105	602-275-4505
Alexander Tech	38	32	515-423-8955
Anritsu Company	43	36	800-ANR-ITSU
Antenex	89	100	800-323-3757
Apco National Conf.	51	44	904-322-2500
Astron Corp.	1	13	949-458-7277
Avtec, Inc	13	12	803-892-2181
Beam Radio	80	68	305-477-2326
Berkeley Varitronics	11	10	908-548-3737
Carlson Wireless Tech.	15	4	707-923-9593
Centurion Int	47	40	402-474-1344
Chargeguard Corp.	69	56	800-458-3410
Chargeguard Corp.	20	18	800-458-3410
David Clark Co, Inc	65	54	508-751-5800
Comms. Specialists	BC	3	800-854-0547
Comnet- Ericsson	23	21	804-528-7456
Computer Resources Inc.	95	118	205-987-1523
Connect Systems	67	55	800-545-1349
Control Signal Corp.	80	69	800-521-2203
CPI Communications	74	61	972-429-7160
Crescend Tehcnologies	85	75	800-872-6233
Crescend Technologies	91	106	800-872-6233
CTI, Inc	68	60	662-287-8081
Dataradio	28	25	770-392-0002
Datron World Comms.	16	15	760-597-3814
Diversified Electronics	60	50	404-361-4840
DLC	12	11	562-404-9998
Duracomm Corp.	22	71	816-472-5544
EAGLE	76	57	520-204-2597
EAGLE	85	76	520-204-2597
Earmark	84	73	203-777-2130
EDX Engineering	34	29	541-345-0019
El Paso Comm. System	89	111	915-533-5119
EML	89	102	615-771-2560
E-tronics Battery	55	47	403-735-6222
Fiplex Comms.	83	72	305-884-8991
Fiplex Comms.	91	108	305-884-8991
The Genesis Group	95	117	903-561-6673
Glentel	79	67	604-415-6578
Hutton Communication	49	42	800-442-3811
ICOM America	45	38	206-450-6041
IDA Corporation	46	39	701-280-1122
I-Tech	26	23	619-458-1500
Jbro Batteries	72	77	800-323-3779
JEI Communications	77	64	530-677-3210
Jotto Desk	22	70	501-636-5776
JPS Communications	16	14	919-790-1011
Kaval Electronics	25	22	905-940-1400
Kenwood Comms.	27	26	800-950-5005
Klein Electronics	48	41	760-781-3232
Klein Electronics	92	110	760-781-3232
Marketronics Corp.	61	51	954-846-1011
Merry Electronics (USA)	84	74	626-333-8985
Midian Electronics	37	31	520-884-7981
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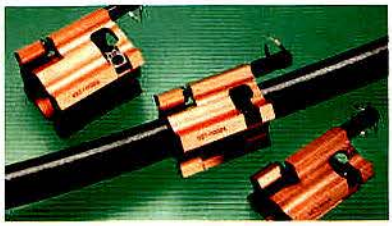
Software allows system planning

The Celplot3D and Microwaveplot from **Radio Frequency Systems** are downloadable RF software tools that aid RF engineers and wireless system planners in selecting the right antenna for the coverage job at hand without having to plug in complex trigonometric functions. Celplot3D displays digitized base station antenna data from the RFS product line in three dimensions. The software permits the wireless system planner to simultaneously view the vertical and horizontal beam patterns of a particular antenna combined into one 3D view. Microwaveplot evaluates and displays the digitized patterns and rejection characteristics of microwave antennas.

WWW.RFSWORLD.COM

Midspan strip tools work for LMR cables



Four midspan strip tools are available from **Times Microwave Systems** for use with LMR feeder cables sizes 600 through 1700. The GST-600A, 900A, 1200A and 1700A tools provide a way to remove the outer polyethylene jacket on LMR feeder cables to prep the cables for attaching ground kits. Made from aluminum with a steel blade, each tool is sized to remove the jacket without damaging the underlying coax cable shield.

WWW.TIMESMICROWAVE.COM

Meter evaluates signal coverage

Model R-505C field strength meter from **Z Technology** is a rugged, portable instrument that evaluates signal coverage across a service area, analyzes signal strength at a specific location and makes NIST-traceable field strength measurements. It is battery-operated and fully synthesized. The standard product covers 5MHz to 1,000MHz and allows tuning in 1kHz frequency steps. The meter has a 100dB dynamic range, measuring signals from 10dBμV to +90dBμV.

WWW.ZTECHNOLOGY.COM

Richard "Dick" Alexandres remembered

On Sunday, Feb. 18, of this year, Dick Alexandres passed away at his home in Cape Coral, FL. Dick was 72 years old.

I couldn't let his passing go without comment.

Probably a lot of you didn't know that the founder of Alexander Manufacturing was actually Richard Alexandres.

Over the years, Dick and I had become friends in terms of friendly competitors. I always respected what he had accomplished and he always treated me with courtesy and respect. His fundamental accomplishment is what may be overlooked in his passing. I want to thank him for what he did.

I first met Dick some 30 or more years ago when I was selling batteries for Union Carbide (Eveready at the time). He was still in his storefront business on Railroad Avenue in Mason City, IA.

From that location he was servicing a string of "U-TEST-M" TV tube checkers throughout northern Iowa and southern Minnesota. In those days most of the "U-TEST-M" locations had picked up on being able to merchandise radio batteries along with the TV receiver tubes they were selling. In most cases inventories were put in on consignment, and these tube checker businesses were moving quite a few batteries at retail.

With that in mind, Dick had some experience with batteries when a trainman came into his store to see if he had replacement batteries for the Motorola HT200 hand-held radio that they were using on the railroad. Motorola was falling down on its ability to furnish spare batteries for the radios since all of their production was being used up with new radios. I was pretty familiar with the problem since Union Carbide was the OEM supplier to Motorola for that radio.

Dick, the handyman, tinkerer, inventor, didn't have the battery available for sale but thought he could probably fabricate a replacement for it in his shop. The rest, as they say, is history.

What Dick did went way beyond the establishment of a very successful manufacturing company. He recognized that the major manufacturers of rechargeable battery assemblies were not prepared to service the aftermarket for these products but, rather, focused on supplying product at the OEM level. This realization caused his company to expand exponentially in the course of a very few years. It also opened the door to a segment of the market through which many other companies would pass. He recognized this and literally created what was to become known in the battery industry as the "fabricator" segment. A part of the industry which has, at times, accounted for as much as 36% of the total market.

Over the years, many companies have walked through that open door of opportunity which Dick provided—Multiplier Industries, JBRO Batteries, Centurion, TDI Batteries, Engineered Assemblies, Access Battery, Fedco—and the list goes on.

All of us have Dick Alexandres to thank for leading the way to opportunities that weren't recognized until he seized on and capitalized on them.

I, for one, want to thank you Dick.

—Jack Brophy
Founder
JBRO Batteries

Question for two-way mobile installers

I'd like to read or hear how two-way mobile installers have coped with the challenge of installing and wiring roof-mount antennas on some of the 2001 automobiles containing cloth-over-foam-glued-to-the-roof liners, such as the Ford Crown Victoria.

—Richard Shima
FM Communications
Mayfield Heights, OH
RShima@att.net

Changing Channels

Crosby

Smith

Changes at the Industrial Telecommunications Association, Arlington, VA:

Mark Crosby departs his post as president of ITA to become president at Access Spectrum LLC. He will continue as senior policy advisor at ITA. **Laura L. Smith,** executive director, government relations, advances to president of ITA. **Howard N. Levitas** leaves Verizon Connected Solutions, New York, as manager, applications development to join ITA as chief information officer, management information systems.

Jack Benz resigns as chairman of the board at RF Industries, San Diego.

Ken Nair departs Magnetek, Los Angeles, as director of engineering and technology to join Trilogy Communications, Jackson, MS, as vice president of operations.

Pace A. Duckenfield leaves the Alliance for Public Technology, Washington, as staff counsel to join the United Telecom Council, Washington, as associate counsel.

Changes at the Cellular Telecommunications and Internet Association, Washington:

Bruce Cox departs AT&T as vice president of congressional and regulatory affairs to join CTIA as vice president for regulatory policy and law. **Robert Roche,** who has headed the research department since 1993, advances to vice president for policy and research.

Del King leaves Greenville County, SC, where he was in charge of E9-1-1 systems to join HTE, Lake Mary, FL, as director of the public safety and justice products division.

Marc Cases departs Magneti Marelli, a Fiat subsidiary in Turin, Italy, as manager of corporate outsourcing to join Wavecom, Issy-Les-Moulineaux, France, as corporate manufacturing director.

Don Mathison joins Starpower Communications, Washington, as general manager after holding senior leadership positions in marketing, programming and customer service for Media General Cable, Fairfax, VA; Group W. Cable, Santa Monica, CA; Colony Communications, Providence, RI; and Time Mirror Cable Television, Irvine, CA.

Robert L. Brown is elected chairman of GSM North America, Washington, and will continue to serve in his current position a North American GSM Alliance LLC executive director.

April

1–4: ENTELEC, sponsored by ENTELEC, New Orleans. Contact: 281-357-8700 or Web site **www.entelec.org.**

24–27: APCO North Central Regional Conference, sponsored by the Association of Public Safety Communications Officials–International, Radisson Hotel, Bismark, ND. Contact: Rick Hessinger, 701-328-8153.

May

6–9: Spring Vehicular Technology Conference, sponsored by the IEEE Vehicular Technology Society, David Intercontinental Hotel, Tel Aviv, Israel. Contact: 972-3-6133340 or **congress.co.il/ieee_news/index1.html.**

13–17: APCO East Coast Regional Conference, sponsored by the Association of Public Safety Officials–International, Lancaster Host Resort, Lancaster, PA. Contact: Jay Groce III, 610-344-5084.

16–18: PCIA Tower and Site Management Conference, sponsored by the Personal Communications Industry Association, Doral Golf Resort and Spa, Miami. Contact: 703-739-0300.

21–24: Telecommunications Resellers Association Spring Conference and Exhibition, sponsored by TRA, Adam's Mark Hotel, Dallas. Contact: **www.tra.org.**

June

3–7: Supercomm, sponsored by TIA and USTA, Georgia World Congress Center, Atlanta. Contact: 800-278-7372.

24–27: UTC Telecom, sponsored by UTC, the United Telecom Council, Midwest Express Center, Milwaukee. Contact: 202-857-1881 or **www.utc.org.**

24–28: NENA, sponsored by the National Emergency Number Association, Orlando, FL. Contact: Web site **www.nena9-1-1.org.**

July

15–18: Forestry Conservation Communications Association National Conference, Olympia, WA. **www.mashell.com/~roblee/fcca.htm.**

August

5–9: Association of Public-Safety Communications Officials–International (APCO) National Conference, Salt Lake City. Contact: 904-322-2500 or **www.apco-intl.org.**

September

11-14: PCIA GlobalXChange, sponsored by the Personal Communications Industry Association, Los Angeles Convention Center, Los Angeles. Contact: 703-739-0300 or **www.pcia.expoventure.com.**

19–22: Private Wireless Spectrum Management Conference & Expo, sponsored by Industrial Telecommunications Association, the Council of Independent Communications Suppliers and the USMSS, Grand Hyatt Hotel, Washington. Contact: Ray Wisniewski at 703-528-5115 or email: **ray@itarelay.com.**

November

6–8: Canadian Wireless, sponsored by the Canadian Wireless Telecommunications Association, Metro Toronto Convention Center, Toronto. Contact: 613-233-4888, ext. 102, or **www.cwta.ca.**

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We all have to learn to think 'outside of the box'

By Lonnie Danchik

If you make it to IWCE in Las Vegas this year, you'll see hundreds of manufacturers, distributors and service providers hawking their wares. They'll be showing off lots of new products and technologies; and they'll be shaking hands, passing out literature and talking 'til they drop.

Why don't radio manufacturers build a mobile "platform" that has a plug-in option board that repeats out to a UHF or VHF portable? That would solve 90% of our customers' needs and keep them from going away.

I've been going to IWCE since its inception, and I have made most of the 25 annual shows. IWCE provides an important and useful function for our industry. But in retrospect, I really haven't seen too many *really* new and *really* innovative things over the years because nobody spends much time thinking *outside the box.*

Let me elaborate.

I imagine just about all of you who own and operate radio systems have had this experience: One of your customers (that has been using fleet-dispatch, mobile two-way radios for years) tells you that it is going with that "Next" company. After all, *its* service is a radio, a phone and a pager, and it has text messaging ... you name it.

Because *you* don't offer anything like that, the decision has been made: "Turn us off at the end of the month."

A year goes by, and you happen to be out making a call in the area of your old customer, so you drop by to say hello. Lo and behold, they're not using "Next" anymore.

"Nope. Too expensive, too much trouble, limited to one-to-one, company's too hard to deal with...." (You know the drill.)

So you ask, "What *are* you using?"

"Why, we decided to go with cellular," they reply. "We needed the portability and the wide area of operation."

"But," you exclaim, "*it's* expensive, you still don't have *any* type of dispatch, and *it's* dial-up, one-to-one too."

"Yeah," they reply, "We kind of hate that, but it sure is convenient for our workers to have the communications *with* them, not stuck in their vehicles."

Box? What box?

This little story has two elements that I want to expand on to show you why we need to start thinking outside the box.

▶ *Portability* — We all know the problems that the average two-way system has with portables, compared to the coverage expectations of a cellphone. But *our* typical customer is someone who drives to a location and then gets out to do his job. Typically, he's less than a few hundred feet from his vehicle.

So why don't radio manufacturers build a mobile "platform" that has a plug-in option board that *repeats out* to a UHF or VHF portable? That would solve 90% of our customers' needs and keep them from going away. I'm not talking about a $1,000-plus vehicular repeater. That's way too expensive. I mean a $250 option that talks to a $250 portable.

Sure, the *whole package* (mobile, option board and portable) might cost $1,000, but a little creative financing can get that down to $199 down and $49 per month, *including air time.* (Wow, what does *that* sound like?)

Those plug-ins could also include things like GPS receiver modules and digital voice recorders.

▶ *Wide coverage area* — Several manufacturers came to me during the past year asking if we were interested in looking at TETRA because of its networking capabilities. Problem is, we have mature, loaded systems, and we can't afford to turn everyone off while we change technologies.

TETRA overlay

Finally, I asked one of them, "Why don't you make a TETRA *overlay* that will allow both my current technology *and* TETRA to work on the same RF backbone? Then *you* could sell dual-mode radios, and *I* wouldn't lose anyone."

Speaking of portables ... how about a VHF, UHF or 900MHz trunked portable, with a widescreen display and a POCSAG or Flex option, that would work as a two-way radio *and* as an alpha pager on a local paging system that the two-way dealer could be a reseller for or own?

Well, I could go on, but space here doesn't allow me to go into other examples of outside-the-box thinking. But *I'm* starting to do it. Of course, I think if we're going to survive, we've *all* got to start doing it.

Let me know what *you* think. ■

Danchik is president of CommNet Communications, Dallas, and chairman of Small Business in Telecommunications. His email address is **commnetc@aol.com**.

"Point-of-Sale Perspective" is a guest editorial column contributed by and for ***MRT's*** radio dealer readers. Opinions expressed here are edited for space; they are those of the author, and may or may not reflect editorial positions of ***MRT.***

MRT pays a writer's fee for each "POS Perspective" column accepted for publication. Commentaries should be about about 700–800 words long.

Dealers interested in contributing to this column should contact David Keckler, technical editor, by email at **david_keckler@intertec.com.**

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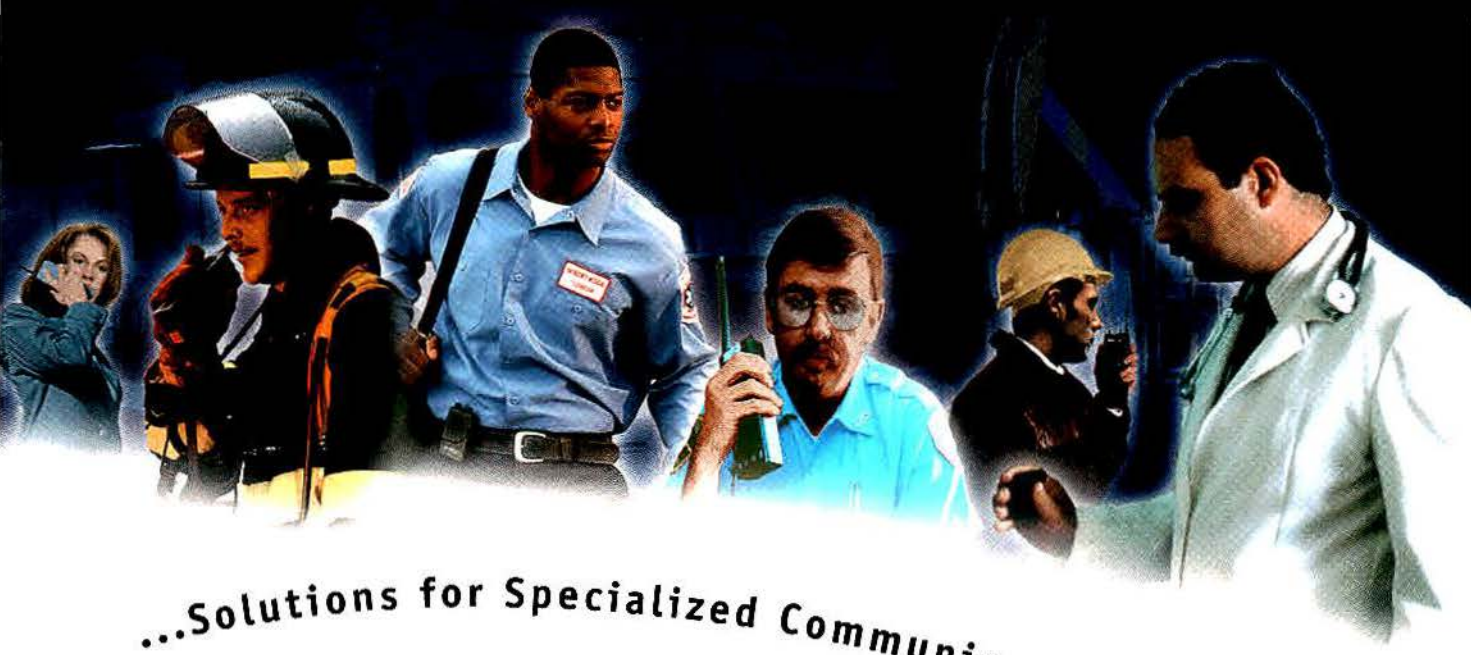

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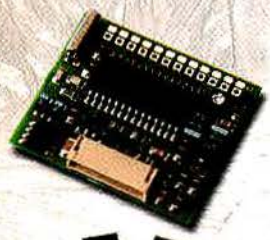

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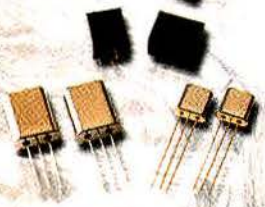

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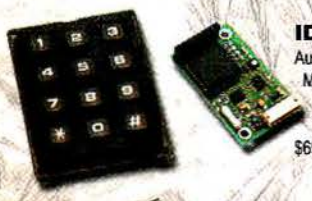

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